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THE VIRGINIA JOURNAL OF SCIENCE

VOL. I, NEW SERIES No. 2

Modern Development of Mathematics

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Mathematics in general, and its modern phase in particular, is supposed to be a very specialized and ethereal subject all but inaccessible except to the highly trained mathematician. The latter, by popular concept, lives with his head in the clouds and speaks in a language which not even other mathematicians can understand. However, mathematics is credited even in the popular mind with being built on firm ground. Its conclusions stand the tests of time and of changing political and social revolutions. They are only enhanced in value and more universally appreciated rather than replaced as newer and better scientific discoveries and industrial and economic developments are evolved with or without their help.

It is not to be denied that the mathematics of today is a highly technical, difficult, penetrating and complicated subject. It deals with situations which are abstracted and idealized and which arise frequently out of the free wanderings of a fertile imagination. It employs every conceivable kind of symbolism and notation for expressing its concepts and relationships and condenses its conclusions and reasonings to such an extent as to make its reading far from an effortless pastime even for the specialist.

Mathematics is a highly abstract science. Indeed by its very nature it must be so. All mathematics is abstract, there isn't any other kind. The impression that there are several varieties of mathematics varying in concreteness from the foundations to the applications — roots to the fruits as it were — is erroneous. There is only one mathematics. We have studies and development on the subject on the one hand and applications on the other. Calling the latter "applied mathematics" instead of "applications of mathematics" is a misnomer, though not a very serious one.

However, I do not need to dwell on the question as to the nature of mathematics. The logical deduction of conclusions from a consistent set of assumptions constitutes a science which we all meet in high school and which remains a part of us ever thereafter. My objective will be rather

Editor's Note: In continuing the policy established by the Editorial Board to present in the first three numbers of each Volume of the Journal an article of general interest and progress in the several fields of science, we have invited Professor G. T. Whyburn, Chairman of the School of Mathematics at the University of Virginia, to contribute this article from the field of Mathematics.

to indicate first the extent to which the postulational approach and the tendency toward abstraction have permeated all of mathematics; then to show by illustrations some of the advantages of these methods and some of their limitations; and finally to indicate how in spite of its many parallel developments in separate fields leading to high specialization, we are continually encountering new concepts and methods which cut horizontally across the subject and result in a beautifully unified whole with artificial barriers removed. Hence the end product toward which we are working is the conclusion of such beauty and simplicity as to be appreciated and understood by everybody.

The postulational formulation of mathematical results goes back at least to Euclid and the Greeks in geometry. Almost certainly the geometric relationships and truths were first observed to hold in many cases, then found to persist under conscious experimentation, and finally they were roughly proved. Eventually, however, a certain body of these theorems was collected by Euclid and a set of axioms formulated on which the proofs of all could be based. This led to other theorems not previously suspected but which were seen to follow logically from the axioms and which stood the most rigid tests of application to specific instances. A constant review of the axioms themselves may well have accompanied this evolution of the subject. Euclid at least was conscious of possible redundancies in his axioms, as evidenced by his efforts to prove the parallel postulate from the others; and he was mindful of weaknesses introduced by leaning on the nebulous operation of superposition. The story in geometry is a very familiar one to all of us. It was climaxed in the non-euclidean geometry by Bolyai and Lobachevsky in the 19th century and was perfected and put in very nearly final form by Hilbert, Veblen, R. L. Moore and others at the end of the last and beginning of the present century.

It is not generally so well known to what a very great extent the other branches of mathematics have been axiomatized in precisely the same manner and how this has resulted and is resulting in tremendous enrichment of these fields. This is a comparatively modern development in mathematics. Traditionally algebra and analysis are manipulative subjects with the emphasis on solutions of equations or roots of polynomials on the one hand and on differation and integration techniques on the other.

In the masterful hands of George Boole, Sylvester, Cayley and others, during the 19th century, abstract assumptions for an algebraic system were extricated from the mass of accumulated results of specialized nature, and modern algebra was born. Thus it came to be realized that algebra itself is nothing more than an abstract system—an abstract development of the consequences of a set of postulates without necessarily

any interpretation or application to numbers or anything else. Peacock in his "Treatise on Algebra" (1830) broke away from the superstition that x, y, z . . . in relations such as $x + y = y + x$, $xy = yx$ and $x(y + z) = xy + xz$ necessarily stand for numbers. That they are perfectly arbitrary symbols standing for *undefined* elements which are restricted only by the rules laid down in the axioms is one of the most important things about algebra and is the source of its power in applications. Boole separated the symbols of mathematical operations from the things upon which they operate and investigated these operations on their own account. He asked himself *How do they combine?* and, *Are they too subject to some sort of symbolic algebra?* He found that they were. He went on from this point to the creation of his own masterpiece, namely, a simple workable system of symbolic logic, called algebra of logic, in terms of the simplest and most basic algebraic postulates. From Boole's time on to the present (Boole was a contemporary of Lincoln) we have almost exclusively advancements in algebra in the abstract direction, the postulational viewpoint being adopted as a matter of course. Advances have indeed been rich and spectacular and they continue to be so. The concepts of an algebra and of a group as abstract mathematical systems have permeated nearly all other phases of mathematics and overflowed the banks of mathematics into theoretical physics and mechanics. However, I expect to return to this point a little later.

In analysis the monumental work of Cantor and Dedekind on the construction of the number continuum succeeded in placing the subject on a postulational foundation. Cantor's method was to adjoin numbers to the natural number system (already on an axiomatic foundation in algebra) according to specified rules so as to obtain the rational number system and then, using regular sequences, to adjoin similarly the rationals to this to obtain the real number system. Dedekind's approach was more postulational in spirit but, of course, arrived at the same place. Both procedures are highly satisfactory and succeeded in creating the solid foundation on which modern analysis rests so firmly.

Now to mention briefly a few of the many specific fields of study in which axiomatization has been used to great advantage comparatively recently: First, I would like to point out that the work of E. H. Moore on General Mathematics and his influence in this country has been more powerful than any other force in the modern development of mathematics along the lines in which exploitation of the postulational method is paramount. In integration the work of Lebesgue pointed the way to a broadening of this concept and an understanding of it as a mathmatical science within analysis which was capable of much greater applicability. It too has been set up in axiomatic form with the basic properties of integrals taken as axioms. For example, the integral of a function f over a set E

may be defined as a number associated with f and E and satisfying conditions such as: (1) the integral of the sum of two functions is the sum of their integrals, (2) the integral of a constant c times a function f is c times the integral of f, and (3) the integral of the function f which is equal to 1 everywhere on E is equal to the measure (length, area, volume) of the set E.

Similarly in topology, a comparatively new field of study growing out of the work of Cantor and Dedekind, on the set-theoretic side, Euler and Poincare on the analytic side and from a study of the foundations of geometry, we have especially fine examples of the fruitfulness of the axiomatic approach. R. L. Moore in 1916 gave a set of axioms for the plane or sphere. Perfected by later workers this set reduces very simply to the beautiful result that a closed, bounded, connected and locally connected space is a topological sphere if and only if it satisfies the axioms:

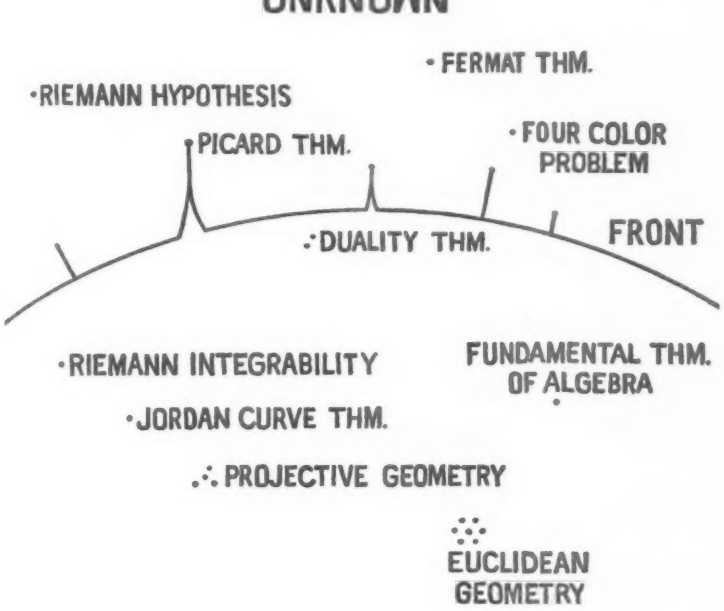
1. Every simple closed curve on it separated it.
2. No pair of points on it separates it.

Frechet, Hausdorff, Kuratowski and others formulated and studied sets of axioms for topological systems which have proved of fundamental significance in nearly all fields of mathematics. Urysohn and Tychonoff perfected a set of axioms characterizing in topological terms those spaces on which a natural distance may be defined, and so on.

Algebraic Geometry, a difficult and formerly inaccessible field to many mathematicians, is just now yielding to the abstract postulational approach. Here we have the study of higher dimensional algebraic varieties through the medium of all the highly developed mechanisms of algebra, analysis, geometry and topology. Contributions of Lefschetz, Zariski, Hodge and others to this field during the past 25 years have been most outstanding and have brought the subject to such a state of advancement that axiomatization can at last be attempted. This was achieved with considerable success by Andre Weil in his recent book in the American Mathematical Society Colloquium series.

I could continue with example after example of this same sort where the postulational method has been and is being introduced into a field of study to fix the concepts and organize the results and point the way toward new theorems. For example, in the theories of 1) measure, 2) dimensionality, 3) length and area and 4) dynamics and flows. However I must go on.

The situation in mathematical knowledge at any one time could be pictured somewhat as indicated in the following figure.



Developments take place by advancing the frontier and this happens in several ways.

1. We stake out new theorems in the unknown realm. These remain as conjectures until proven. Frequently the proof gives us only a *connecting line* rather than a broad extension of the front to include the new result. Thus the front is advanced only along these lines projecting into the unknown.
2. We advance the front broadly between stakes previously connected only by narrow lines to the known.
3. We advance the front broadly by expansion not attached to stakes in the unknown. This frequently results in the engulf-

ment of isolated stakes set out as conjectures and not previously proven. Thus not only are these proven but we are enabled to see the whole picture and setting. We can see why they hold and how they fit into the structure of mathematical knowledge.

In general the abstraction and postulational procedure plays a role in all three types of advances, although its position is much more central in the broad type of progress than in the linear advance which leans so heavily on brilliant glimpses into the unknown by the genius. The formulation of the problem in its abstract setting focuses our attention on its essential difficulties and enables us to bring our most effective methods to bear on them. Also, after the problem is solved and the theorem proven by whatever means, and usually the first proof is far from the most direct or the best but rather represents a sequence of rough and halting steps taken uncertainly in several directions, we look back over the proof and ask which steps were really helpful in getting to the result, which assumptions were essential and what are the fundamental principles on which the new truth rests. Thus the theorem and its proof are abstracted from the extraneous information and given their true setting. In this way we can see what makes it work and the proof becomes easier, frequently quite easy. It proceeds directly from necessary assumptions in abstract form to the conclusion; and the way is not cluttered by unnecessary information or assumptions which tempt us to use specialized techniques and machinery just because they are available.

Suppose we illustrate with the Borel Theorem. This celebrated theorem has had a most interesting history in analysis and topology which is too long to be told in detail here. First discovered in connection with studies of functions of real variables concerned with uniform continuity, uniform differentiability, integrability, etc., it states that —

Given any closed and bounded set K *of points covered by any collection* G *of open sets,* K *is also covered by some finite subcollection of* G.

An open set on a line is a set which is made up of intervals with their end points removed, on a plane it is a set made up of circle interiors, on a 3-space a set made up of interiors of spheres, and so on. The theorem says, for example, that if the top of a table is covered by cards so that each point of the table top is under at least one card and not on the edge of this card, then some finite collection of the cards would also cover the table top. There would be no way of covering it by any collection of cards but what a finite number of these cards would cover it just as well.

Naturally, the theorem was first proven for sets on the real number line. It was first proven using much of the special properties of the real number system, somewhat as follows:

1) case where K is an interval

2) case of general K

3) generalize to plane sets and higher dimensional sets—by complicated technique using coordinates.

Close study of the theorem showed, however, that it rested essentially on the simple property of *compactness* of closed and bounded sets in Euclidean spaces and not at all on the fact that these sets were in Euclidean spaces. Thus the theorem assumed the abstract form (a set is compact if every one of its infinite sets has a limit point in the set):

THEOREM. *Any open covering of a compact set in a metric space can be reduced to a finite covering.*

The proof of this much more inclusive theorem then is easier than even the simplest cases of the original form. It proceeds as follows:

We first show that any open covering of any set in a separable metric space reduces to a countable covering (Lindelof Theorem). Thus we may suppose our set K is covered by a countable sequence $G_1, G_2 \ldots$ of the sets in the given collection. Then if for each n we define K_n to be the part of K not covered by the union of the first n of the sets G_i, we can show that K_n is empty for some n; for if not, we could take a point p_n in each set K_n and the set of such chosen points (p_n) would have a limit point p in K by the compactness of K. But then p lies in G_k for some k and this is not possible since K_n does not interest G_k for $n > k$ whereas G_k would have to contain infinitely many of the points p_n.

Thus the Borel covering theorem for Euclidean spaces reduces to showing that closed and bounded sets in Euclidean spaces are compact. Now why is this so? The answer is quite simple. It is so for the 1-dimensional case primarily because the real number system is constructed so as to make it so (Bolzano-Weierstrass Theorem); and for higher dimensional spaces it is a direct consequence of the construction of n-space as the product of n 1-dimensional spaces (lines).

In conclusion, I would like to indicate by illustration the very satisfying trend which persists in present day mathematics of new and not so new concepts in one field serving to break down barriers between fields and thus effect the amalgamation, simplification and strengthening of mathematics as a whole. I will illustrate this with the concept of a *group*.

A group is a mathematical system consisting of a set G of undefined elements and a law of combining these elements usually called addition or multiplication and indicated by $+$ or . satisfying the simple rules or axioms:

1. For a, b ϵ G there is a unique element a + b in G (ϵ means "element of).
2. a + (b + c) = (a + b) + c (= means "same element as")
3. There is a neutral element O satisfying a + O = a, a ϵ G
4. For a ϵ G, there is an inverse a′ or (-a), satisfying a + (-a) = O. The group is abelian, or commutative, if it satisfies
5. For a, b ϵ G, a + b = b + a.

Groups may be very simple or very complex. For example, the real number system is an additive group with ordinary addition and neutral element O, as are also the rational, integral and complex number systems. The positive rational numbers form a multiplication group with neutral element 1. Likewise the complex numbers of modulus 1 form a multiplicative group with 1 as neutral element. All of these are examples of infinite groups. However, a group can have 1, 2, 3, . . . or any finite number of elements. For example, two numbers O and 1 form a group with neutral element O if addition is defined by the table

$$\begin{aligned} O + O &= O \\ O + 1 &= 1 \\ 1 + O &= O + 1 = 1 \\ 1 + 1 &= O \end{aligned}$$

However, elements of a group need not be numbers; and I wish to indicate how by exercising the freedom of choice implicit in the abstract formulation of the group concept this idea has been used in topology with remarkable effectiveness. This is by no means an isolated example but is typical of what is happening throughout our subject not only with the group concept but with numerous others as well.

In topology one of the oldest and best known theorems is the Jordan Curve Theorem stating that a simple closed curve in a plane separates the plane into just two regions and is the boundary of both of these regions. Various kinds of extensions of this celebrated theorem have been given from a purely set theoretic approach; e.g., to more general kinds of sets in the plane, sets dividing the plane into more than two regions and so on. Some success was achieved in extensions to higher dimensional spaces than the plane, though this seems pretty meager now as we look back on these attempts. Now let's see how the group concept enters the picture.

We consider first as elements the oriented simplexes of all dimensions . A 0-dimensional simplex x^0 is merely a single point. A 1-simplex x^1 is an interval with a prescribed ordering of its end points. A 2-simplex x^2 is a triangle with a prescribed ordering of its vertices. Similarly

a 3-simplex x^3 is a tetrahedron with a given ordering of its vertices, and so on. We then take a set which can be cut up into simplexes of this sort (which may be curved) and form complexes or *chains* of various dimensionalities which we write as sums:

$C^r = \sum_i t^i x_i^r$ ($t^i \in G$, an abelian group, only finite number of the t's not 0). The set of all such chains of a given dimension r on a set or complex K forms an additive abelian group $L^r(K)$ with respect to the simple rule

$C_1^r + C_2^r = \sum_i (t_1^i + t_2^i) x_i^r$, where $C_1^r = \sum_i t_1^i x_i^r$.

Next we introduce the notion of *boundary* of a chain. First for a simplex x^r we get a chain of its r-1 dimensional sides

$\dot{x}^1 = a_1 - a_0$, $\dot{x}^2 = x_1^1 + x_2^1 + x_3^1$, $\dot{x}^3 = x_1^2 + x_2^2 + x_3^2 + x_4^2$, and so on.

For C^r we get $\dot{C}^r = \sum_i t^i \dot{x}_i^r$ for the boundary of C^r.

Any chain C^r with $\dot{C}^r = O$ is called a *cycle*. The class Z^r of all cycles in $L^r(K)$ is a sub-group of $L^r(K)$. The class of all cyles which *bound* form a sub-group $H^r(K)$ of $Z^r(K)$. The residue class group (or factor group) $Z^r(K) - H^r(K) = B^r(K)$ turns out to be of deep topological significance. Its elements are classes of mutually *homologous* cycles (two cycles being homologous provided their differences bounds a chain on K.)

Let us examine briefly what it can do for us in topology. In the first place its structure is a topological invariant — unchanged under any 1-1 bicontinuous transformation of the set K. Further we have the remarkable duality theorem of Alexander (1921) relating the structure of these groups for a set K in Euclidean n-dimensional space R^n with those of its complement R^n-K. In terms of *ranks* of these groups, where the rank of a group G is the maximum number p(G) of linear independent elements of G, this theorem says—

$p^r(K) = p^{n-r-1}(R^n - k)$, $\quad 0 \leq r \leq n-2$;

$p^{n-1}(K) = p^0(R^n - K) - 1$.

Now p^0 is the number of components (pieces) in the set K so that $p^0 = 1$ if set is connected.

To see how the theorem applies, we note first that for a set K in the plane R^2 it gives

$p^0(K) = p^1(R^2 - K)$

$p^1(K) = p^0(R^2 - K) - 1$

Thus for a simple closed curve K, since $p^1(K) = 1$ we get $p^0(R^2 - K) = 2$ so that there are two pieces in the complement of K and we obtain the Jordan Curve Theorem.

For a set K in three space R^3 the theorem asserts:
$p^0(K) = p^2(R^3 - K)$
$p^1(K) = p^1(R^3 - K)$
$p^2(K) = p^0(R^3 - K) - 1.$
Thus if T denotes any set in R^3 which is topologically equivalent to the torus (anchor ring) and S any set topologically like a sphere, the duality theorem gives the relations in the following table.

	p^0	p^1	p^2
T	1	2	1
$R^3 - T$	2	2	1
S	1	0	1
$R^3 - S$	2	0	1

In particular, note that since p^0 is 2 for the complements of both T and S, it follows that any such sets must separate R^3 into exactly two regions.

Thus we have not just an isolated result such as the Jordan Curve Theorem but the whole beautiful picture revealed through the medium of the group concept and reached by means of the algebraic mechanism made available by expressing topological relations in algebraic language. Now I repeat and emphasize that this is no isolated instance even in topology. Indeed, the fusion of algebra and some phases of topology has proceeded to such an extent that some current books on topology are devoted almost 100% to development of the necessary algebra with the topology entering only in the last page! Also, other concepts and techniques from various fields are being used with equal effectiveness even in topology, notably the functions and mappings of analysis. Finally, it is not only topology but all other fields as well which are having the happy experience of being fused and integrated into the modern mathematical and scientific scene. Thus we see that the new developments in mathematics are not exclusively in the direction of greater specialization and useless generalization but really lead toward advancements of the frontier along broad lines so that the whole picture is exposed in a nicely arranged simplicity.

A Little Knowledge

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Once in a while we see a character who disturbs the prudent mind by making positive, unqualified statements on subjects about which he knows very little. This character never tempers his assertions with such modifying phrases as "it seems" or "I have been informed", but straightway proclaims his observations and opinions as facts. He knows, and so there is in his assertions a certain quality of finality that suggests a challenge to contradiction.

The assumption of incontrovertible fact is a characteristic not infrequently seen among men in all stages of life, but it is more common among the inexperienced. Young men, impelled by the vigor of youth, rush to college to study a trade or the classics. But when a smattering of general information is received, they become vainglorious, and assume they are prepared to deliver preceptive judgments and issue opinions as positive truth. The student who has completed his first basic course is far more inclined to assert the truth of an hypothesis, or take issue on some technique, than the student who has mastered the more advanced phases of his subject. If he goes into business, or joins a research staff, he immediately sees the defectiveness and abuses of his firm, and with bold positiveness recommends the revisal of some establishd principle. But instead of receiving admiration for this, there is only the scorching eye of his superiors, and the coldest opposition to his plan. He is unaware that incapacity and inexperience might bring even greater dangers in its train than a policy establishd by older heads, howsoever weak that policy might be. There is an ancient axiom which says that "A little knowledge is a dangerous thing", but the undisciplined mind does not see the implication of this truism. The shallowness and pretense that accompanies prematurity is inescapable, and the youth who would accept authority before he is ready for it must risk the hazards of matching his wits with seasoned professionals.

There is no sudden way to fame. We advance by industry and perseverance, but in easy stages. At each step we gain something and, it may be, lose a little. And with each step there must be sufficient time for the consolidation of character. A certain tolerance seems to be allowed for defect and error — for the culture of experience — but always there is a limit beyond which we must not go. "First the blade, then the ear, after that the full corn in the ear."

The practice of certitude by ignorance has caused untold suffering in the world. Affirmation by an impoverished mind can be, and fre-

quently is, a serious danger to society. Superficial training, supported by many of the modern artificial mechanics of education, is a perpetual creative source of confusion and distorted truth. A course by correspondence, or the over emphasis of simplicity by the elimination of difficult passages, will not produce an enlightened public or a strong executive. A banjo picking Senator, or a ballad singing Representative in Congress, can not reflect credit to the society that supports these officers. What is the modern demagogue except the reflection of the people—minds that are daring, but less adept at analyzing?

I once heard an eminent physicist of international fame make a rather strong statement concerning the amount of vice in one of our large cities. But afterwards he was quick in saying "That's too strong!" Then he toned down his original remark with qualifying phrases, and presented his fact more correctly as he saw it.

In seeing more of life I have met men in all stages of erudition, and my experience is that the more thoroughly acquainted a man happens to be with his subject the less likely he is to make unqualified statements concerning that subject. The well instructed individual knows that truth on any subject is elusive, and that all available knowledge as compared with the unknown is of infinitesimal proportion. The greatest minds in every field of knowledge invariably preface the expression of an opinion or belief with statements that readily acknowledge the uncertainty of all human understanding. They will say, "According to the findings of this individual, thus and thus is so". Or, "It is generally believed by authorities that this is true, etc." The one thing that great students have learned better than any other is the elusiveness of truth. Dalton found the ratio of the weight of hydrogen to oxygen in water to be 1 to 5.5, and published it. Later, he found 1 to 7, and attached more importance to that value. Berzelius found 1 to 7.5, and Dumas found 1 to 7.98, and yet each determination was the true value when it was found. A statement by Herbert Spencer seems to be fitting here. He said, "When a man's knowledge is not in order, the more of it he has the greater will be his confusion".

A Property of the Latus Rectum

EARLE K. PAXTON
Virginia Military Institute

In the American Mathematical Monthly of May, 1946, are published two solutions of the following problem:

> "The top of a certain bridge is 215 feet above the ground and 100 feet wide. Neglecting air resistance, find the minimum initial velocity with which an arrow is shot in order to go over the bridge. At what distance from the base of the bridge must the archer stand? What is the angle of elevation? How high does the arrow go? (Assume the arrow leaves the bow at a height of 5 ft. above the ground)."

It is the purpose of this note to indicate that the path for minimum initial velocity is that parabola whose latus rectum is the width of the bridge. By the use of this method a very simple formula for the solution of problems of this type may be obtained. For the general case let

h = vertical distance of top of bridge above bow, and
$2p$ = width of bridge

For any parabolic path (trajectory) from the archer through a point at the edge of the top of the bridge and in the plane perpendicular to this edge:

V_0 = initial velocity of arrow leaving bow
V = velocity at another point in the path
a = angle of elevation at which arrow is shot
Θ = angle of elevation at the other point in the path

Since air resistance is neglected conservation of energy gives

$$V_0^2 = V^2 + 2gh \qquad (1)$$

This relationship establishes the fact that for a given h, V_0 is a minimum when V is a minimum.

Using a co-ordinate system in the plane of the path with origin at the edge of the top of the bridge, the equation of the trajectory is

$$y = x\tan\Theta - gx^2/2V^2\cos^2\Theta \qquad (2)$$

where V is the velocity at this origin.

When $y = 0$, $x = 2p$ so that

$$V^2 = 2gp/\sin 2\Theta$$

and V is a minimum when $\Theta = 45^\circ$. This minimum is

$$V = \sqrt{2gp}$$

Substituting in (1) gives the minimum value of V_0

$$V_0 = \sqrt{2g(p + h)} \qquad (3)$$

But $V_0 \cos = V \cos \Theta$, so that for minimum V

$$\cos a = \tfrac{1}{2}\sqrt{2p/(p + h)} \qquad (4)$$

To find the point from which the archer may shoot, substitute in equation (2) the values of $y = -h$, $\Theta = 45°$, $V = \sqrt{2gp}$, and solve for x. This gives

$$X = p - \sqrt{p^2 + 2ph} \qquad (5)$$

as the required distance. Similarly with $x = p$ the maximum height of the arrow is obtaind as

$$Y = 5 + h + p/2 \qquad (6)$$

If the origin of co-ordinates is translated to the point, (p, p/2), the top of the trajectory, equation (2) becomes

$$x^2 = -2py$$

the familiar equation of the parabola in which 2p (the width of bridge) is the latus rectum. From this simple equation it is easily shown that every parabola makes an angle of 45° with its latus rectum at the points of intersection.

Using the given numerical data of the problem it is seen that
$X = -103.3$ ft, $a = 71° 56'$, $V_o = 129$ ft./sec, $Y = 240$ ft.

This problem originated from a discussion of the question of the physical possibility of one being able to throw a stone over the Natural Bridge of Virginia. This feat is alleged to have taken place in 1858. The dimensions of this problem are those of the Natural Bridge. Although the above solution does not settle the question, it gives some basis for further observation. The initial velocity of 129 ft./sec. directed at an angle of elevation of 71° 56′ from a point 5 ft. above the ground and 103.3 ft. from the base of the Bridge will carry a stone over the Bridge when air resistance is neglected. This latter is a very variable quantity depending on the mass, volume, and shape of the stone and the direction and velocity of the wind.

At this point it may be added that an initial velocity of 129 ft./sec. will give a maximum horizontal range of 520 ft. when directed at an angle of elevation of 45° and neglecting air resistance. There is a record of a ball player throwing a baseball a horizontal distance of 426 ft., 9½ inches. Is this distance with air resistance indicative of greater or less initial velocity than that of the 520 ft. without air resistance, assuming the former was made at an angle of 45°? In going upstream from the base of the Bridge one comes upon higher ground, which gives an advantage to the thrower.

The horizontal range for the arrow in the problem is 306.6 ft., approximately, with a maximum height of 240 ft. The maximum height for the 520 ft. range with the same initial velocity is 130 ft.

Passage of Hog Cholera Virus in Rabbits[1]

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The virus of hog cholera is not known to be infective for any species of animals other than swine (Hagan, 1939), and while many attempts have been made to transmit the hog cholera virus to other hosts none have been successful. This host specificity of the virus has made studies of this disease difficult since the usual laboratory animals are not adaptable. Cultivation of the virus in hog tissue outside the body has been reported (Ten Broeck, 1941), and artificial propagation by using a modification of Simms-Sanders serum ultrafiltrate method has been accomplished (Boynton, *et al.*, 1948). The transmission of the virus for ten passages in sheep (Zichis, 1939), and more recently, the passage of the virus in rabbits has been reported (Baker, 1946, and Koprowski, *et al.*, 1946). Since the passage of the virus to the rabbit indicated that this animal might be used as a laboratory animal in the study of this disease and that a rabbit adapted virus might be of value in prophylaxis, an attempt was made to adapt a strain of the virus to the rabbit.

MATERIALS

Virus.—The hog cholera virus used was the stock strain employed by a commercial firm for the production of hog cholera virus, vaccine, and immune serum.

Pigs.—Pigs were obtained from local sources at the time of weaning from herds which were free from hog cholera and other infectious swine diseases. The pigs were held in isolation from two to three weeks in order to establish their freedom from disease, and at the time of inoculation they were taken to separate pens and handled so as to prevent cross-infection.

Rabbits.—The rabbits were from a mongrel stock. They were removed from the stock pen at the time of inoculation to a separate room and kept in individual cages.

EXPERIMENTAL PROCEDURE

Two ml. of the stock virus were inoculated intramuscularly into a susceptible pig. On the fifth day at the height of the sickness the pig was sacrificed and the spleen removed aseptically. A 10 percent suspension of the spleen in saline was made and centrifuged at 1000 r.p.m. for 5 minutes. Two ml. of the supernatant were injected intravenously into a rabbit. Temperatures of the rabbit were taken at 2-4 hour inter-

[1] The investigation reported in this paper is in connection with a project of the Virginia Agricultural Experiment Station and is supported by the Research and Marketing Act.

vals, and the rabbit was sacrificed on the third day after inoculation. A 10 percent saline suspension of the rabbit spleen was made, centrifuged, and 2 ml. of the supernatant injected intramuscularly into a pig. Temperatures of the pig were taken twice daily and the pig sacrificed on the fourth day. A suspension of the pig spleen was prepared and injected into a second rabbit.

The virus was carried by this means between the pig and rabbit for six intermittent rabbit passages, and then for five continuous passages

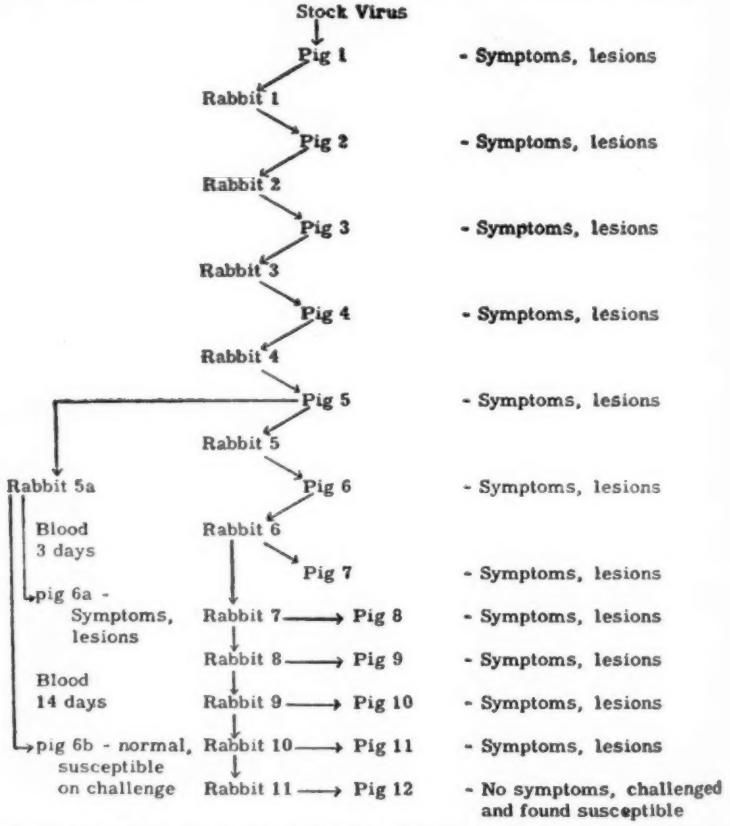

CHART 1. Summary of the Alternate and Serial Passages of the Hog Cholera Virus.

in the rabbit. The time interval between inoculation and sacrifice of the rabbits was between three and five days. The pigs were sacrificed after the development of typical symptoms. At each serial passage of the virus in the rabbit the presence of the virus in the spleen suspension was determined by the inoculation of a susceptible pig. In all cases complete autopsies were performed in order to establish the presence or absence of hog cholera.

RESULTS AND DISCUSSION

The virus was passed alternately from swine to rabbits for six intermittent passages and then for five serial passages in the rabbit. (Chart 1). The pig inoculated with spleen suspension from the 6th rabbit (rabbit 11) in the continuous series failed to develop hog cholera and when challenged after three weeks developed typical symptoms and lesions of hog cholera. The failure to maintain the virus in continuous passage indicates that either the virus failed to adapt itself to the rabbit and was transmitted from rabbit to rabbit without growth or that the virus was lost under the techniques employed. The possibility that some strains of the virus are adaptable while others are not has been suggested (Baker, 1946). These results support this view.

Citrated blood taken on the third day after inoculation from rabbit 5a (5th intermittent rabbit passage) produced typical symptoms and lesions in pig 6a. The injection of citrated blood taken from rabbit 5a on the 14th day after inoculation failed to induce the disease in pig 6b. This pig was found to be susceptible when challenged at a later date.

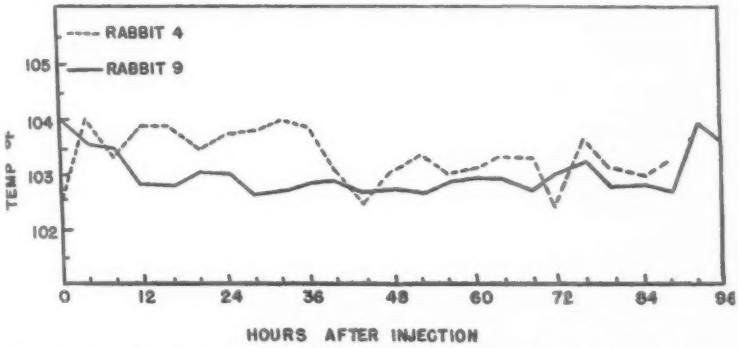

CHART 2. Temperature curve of rabbits injected with fourth intermittent rabbit passage virus and third serial passage virus.

The rabbits did not present any symptoms of illness nor did any develop lesions that might have been related to the injection of the virus

material. Temperatures (Chart 2) taken at frequent intervals did not reveal any febrile response, except in two instances when the rise in temperature occurred within four hours after the inoculation. The lack of a febrile response, which has been previously observed (Baker, 1946, and Koprowski, *et al.*, 1946), may have been due to the inability of the particular strain of virus to become adapted to the strain of rabbits used.

The pigs used to test for the presence of the virus in the serial passages developed the typical disease indicating no apparent alteration in the pathogenicity of the virus for the pig at those stages of passage.

SUMMARY

The hog cholera virus was passed from pig to rabbit for six intermittent rabbit passages and then serially in rabbits for five passages. Attempts to pass the virus to the sixth rabbit in series failed. No febrile response or other symptoms were observed in the rabbits that could be attributed to the virus. Blood taken the third day after inoculation from one rabbit infected a pig, but blood taken the 14th day was non-infective.

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Examination of the Air in a Crowded Gymnasium for the Viruses of Influenza and Herpes Simplex

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It is popularly believed that crowded enclosures such as classrooms, public vehicles, and places of amusement provide superlative opportunity for the spread of virus respiratory tract infections via the air. Clinical evidence also suggests that a number of respiratory disease agents are air-borne.

This report records the results of a search for influenza and herpes simplex viruses in the air of a gymnasium crowded with individuals expelling salivary droplets by coughing, talking and cheering. These two viruses were selected for study because they are reputedly spread by droplets (van Rooyen and Rhodes, 1948), because there is some evidence that they exist endemically (Feller, 1947), and because convenient methods have been developed for their detection and recognition (Hirst, 1945; Beveridge and Burnet, 1946). It was also felt that herpes simplex virus might be a useful indicator of salivary air pollution if it were easily detectable. Both viruses have been reported to be present in "carriers", but there is no available information on their expulsion and survival in salivary droplets. Influenza virus has been shown to survive for some time in air and dust experimentally infected (Edward, 1941; Loosli *et al.*, 1943; Parker *et al.*, 1944), and it has been recovered from such air by means of mechanical sampling devices (Wells and Brown, 1936; Edward *et al.*, 1943).

MATERIALS AND METHODS

SOURCE OF SAMPLES

The area chosen for sampling was a rectangular college gymnasium with an estimated volume of 500,000 cu. ft., and a maximum seating capacity of 5,500. Hot air was blown into the enclosure by a fan at each end; ventilation was provided by an open skylight and one or two open windows near the roof on each side, by two ducts under the seats on each side, and by the swinging entrance gate at one end. Sampling was done during basketball games and boxing matches for the period Dec. 16, 1947 - March 1, 1948.

Air and dust collected at nine basketball games and four boxing matches were examined for the presence of influenza and herpes simplex viruses. At five basketball games and two boxing matches air samples

were taken on the fringe of, or 20 feet away from, the crowd where air-borne dust and droplet nuclei might be expected to constitute the bulk of the air pollution. At four basketball games and two boxing matches air samples were taken in the midst of the greatest crowd concentration so that droplets proper as well as dust and droplet nuclei could have been expected to enter the collecting device.

The air samples, calculated from manometer readings, averaged 186 cu. ft., a small part of the total volume of the gymnasium.[1] However, figuring on a total air volume of 500 ml. and a respiratory rate of 15, this amount is roughly five times that which one individual would inhale in two hours, the average duration of the various events.

Salivary air pollution was provided by a vocally active audience averaging 3,000 and 5,000 respectively and consisting primarily of students drawn from a total enrollment of about 9800. Foci of infection for air-borne respiratory diseases were present in this student population (Table 1), and it was considered that some of the audience could be carriers, either as subclinical cases or as contacts of active cases. The accumulated and possibly infected dust in the gymnasium was conveniently redistributed before each sampling by the practice of dry sweeping and dusting the floor and seats about four hours before sampling began.

TABLE 1. Cases of Air-borne Diseases Admitted to the Campus Dispensary for the Period Dec. 1, 1947 to March 31, 1948.[2]

DIAGNOSIS	NUMBER OF CASES REPORTING			
	Dec. 1 Dec. 20	Jan. 1 Jan. 31	Feb. 1 Feb. 29	Mar. 1 Mar. 31
*Colds	355	201	301	442
**Grippe (influenza)	42	55	45	93
Virus pneumonia	1	1	-	-
Measles	2	1	3	1
Parotitis	1	2	2	1
***Intestinal grippe	19	43	16	14
Chicken pox	-	1	2	2

*Rhinitis, sore throat, no elevation of temperature.
**Elevation of temperature, headache, generalized aching.
***Gastric disturbance, accompanying a cold; throat involvement and headaches; sudden onset of vomiting and diarrhoea; two or three days' duration.

[1] A device capable of collecting a larger air sample in a given time might increase the chances of recovering air-borne virus. The Hi-Vol sampler, designed by Silverman and Viles (1948) and manufactured by Mine Safety Appliances Co., Pittsburgh, Pa., is reported to draw air at 50 to 80 cu. ft. a minute through a thick, pleated filter paper which retains very small-sized particles. We determined that low concentrations of PR-8 virus allowed to dry on the filter overnight could be recovered by shredding the filter in broth in a Waring blendor and inoculating the broth into eggs. Circumstances did not permit an adequate trial of this device under practical conditions, but it should be considered as a possible alternative to the aeroscope devices for this type of investigation.

[2] These cases are only a part of the total number occurring among the students. Those who lived at home or near home did not report to the dispensary.

Since streptococci of the type usually attributed to the respiratory tract were almost always recovered from the air and dust samples (Shirley, 1948), it is evident that the air was polluted by salivary droplets.

Relative humidity at no time exceeded that at which influenza remains viable for more than an hour (Loosli *et al.*, 1943). The final pH of broth and of dust extracts was 6.2-7.0. Influenza A virus has been found to remain infectious at a range of 6.5-7.0; B virus at 7.0-7.9 (Miller, 1944).

COLLECTION AND EXAMINATION OF SAMPLES

Air. The air-sampling device was a modified Folin bubbler tube and flask assembled as shown in figure 1, and was autoclaved before using. Throughout the events, and until most of the crowd had cleared from the area, air was drawn through two bubbler flasks (one on each side of the enclosure) at about one cubic foot a minute by the pump and motor device described by Schneiter *et al.* (1944). Flasks were kept in ice water baths to minimize evaporation and virus inactivation. Sling psychrometer readings were made in mid-evening at one of the sampling sites for relative humidity determination.

Within one-half hour after sampling, the walls of the flasks and of the bubbler tubes were washed with the sampling broth which was pooled, measured, checked electrometrically for pH, and examined for numbers and types of bacteria. One ml. was mixed with one ml. of freshly prepared penicillin solution containing 20,000 units. Six or more 11- to 14-day embryonated eggs, opened over the air space, were inoculated by injecting 0.2 ml. of this mixture into the allantoic cavity for cultivation of influenza virus and by placing 3 to 4 drops on the exposed chorioallantoic membrane for the cultivation of herpes simplex virus. The opening in the egg shell was covered by a sterile half shell. After 44 to 48 hours at 37°C., the eggs were observed for lesions on the chorioallantois; individual allantoic fluids were tested for the presence of influenza virus hemagglutinins by Salk's (1944) method and for bacteria by inoculation of 0.5 ml. into Difco's tryptose phosphate broth with incubation for 48 hours at 37°C. If no hemagglutinins were present, all bacteria-free fluids were pooled and injected allantoically into six more eggs. If this second passage was negative, no further passage was done.

First passage eggs were re-examined for membrane lesions after two more days' incubation. A membrane was recorded as positive for lesions if it showed visible thickening and/or opaque foci over the area inoculated. Suspect membranes were preserved in 1:1 glycerine-saline pending passage in eggs or animals.

Dust. After each sampling period, sweepings were collected from

the floor in front of the stands which had held the greatest crowd concentration. A slurry of this material in proteose extract broth was thoroughly shaken by hand and after the heavy material had settled, one ml. of the supernatant fluid was mixed with 20,000 units of penicillin. Six eggs were inoculated, observed and tested in the same manner as for the air samples.

Controls. The broth from a third flask, made up at the same time

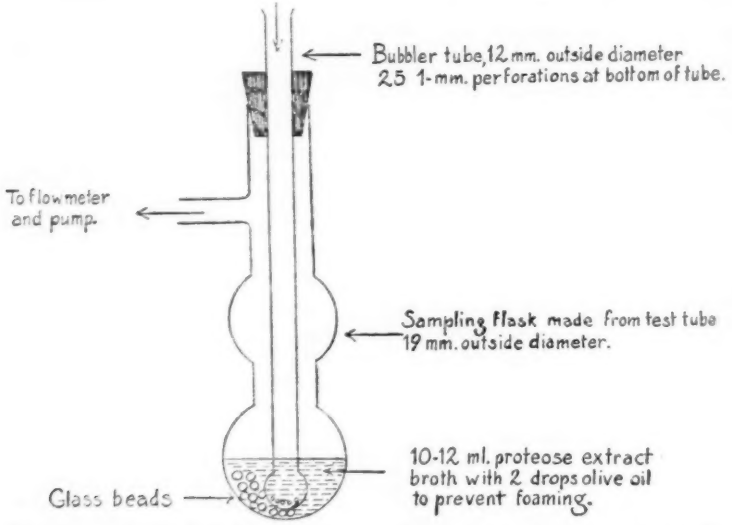
Bubbler tube, 12 mm. outside diameter
25 1-mm. perforations at bottom of tube.
To flow meter and pump.
Sampling flask made from test tube 19 mm. outside diameter.
10-12 ml. proteose extract broth with 2 drops olive oil to prevent foaming.
Glass beads

FIGURE 1. Folin bubbler device as modified by du Buy (1947) for the collection of air samples.

Formula: Protose peptone, No. 3, Difco, 20 gm.; Bacto-beef extract, 3 gm.; Bacto-yeast extract, 3 gm.; Malt extract, Difco, 3 gm.; Bacto-dextrose, 5 gm.; NaCl, 5 gm.; pH 6.8.

as the two used for sampling, was treated with penicillin and inoculated into 6 eggs in exactly the same manner as the broth from the air and dust samples.

Preliminary Experiments. 1. Before undertaking the actual investigation, it was necessary to determine whether the sampling method would inactivate entrapped virus. Allantoic fluid containing egg-adapted PR-8 influenza virus was diluted with proteose extract broth to the least concentration at which it would consistently produce hemagglutinins when 0.2 ml. was inoculated into eggs. This diluted material was placed

in a sampling flask in an ice water bath and air was drawn through it for two hours. The residual broth was then made up to its original volume and carried through the procedure for examination of samples. It was found in three trials that the prolonged aeration did not decrease the viability of the virus determined in this manner and in one instance it appeared to be enhanced. If a 250-ml. Erlenmeyer flask was substituted for the small, round-bottom bubbler flask (one experiment), or if the ice water bath was omitted (one experiment), the virus could not be recovered.

2. It has been reported that one virus may inhibit the multiplication of another when both are inoculated into the same test animal (Henle and Henle, 1945). A limited number of experiments was run to determine this point for herpes and influenza. A brain from a mouse infected with a strain of neurotropic herpes simplex virus (Armstrong, 1943) was ground with sterile sand in 3 ml. of physiological saline, and the supernate diluted to 10^{-1}. One ml. of this dilution was mixed with one ml. of 10^{-6} dilution of PR-8 egg-adapted influenza virus infectious at a dilution of 10^{-8}. This mixture, inoculated into eggs as described above, produced hemagglutinins in the allantoic fluid and typical herpes simplex lesions on the chorioallantoic membranes. The herpes virus alone inoculated into the allantoic cavity did not produce hemagglutinins and the PR-8 influenza virus inoculated onto the chorioallantoic membranes caused only indeterminate lesions. At these concentrations and in the first passage, these two viruses therefore did not interfere with one another's multiplication.

RESULTS

TESTS FOR INFLUENZA VIRUS

Air. Thirteen samples collected under varying conditions of crowding and ventilation were examined. Nine were negative for influenza hemagglutinins. That of Dec. 16, 1947 (Table 2) yielded an apparently pure culture of small, penicillin-resistant, weakly Gram-positive rods considered to be diphtheroids. The contaminated fluids invariably caused a purplish discoloration of the chicken erythrocytes used for the hemagglutination test and some, but not all, contained hemagglutinins which disappeared when the bacteria were removed (Table 2). Other bacteria have also been reported to produce hemagglutinins irregularly in egg fluids (Florman, 1946; Henle *et al.*, 1946).

The sample of Feb. 19, 1948 produced hemagglutinins in the first passage, but all the allantoic fluids were noticeably contaminated with albumin. Second passage eggs were negative. Beveridge and Burnet (1946) report that albuminous fluids sometimes cause hemagglutination. In this investigation all observably albuminous fluids were recorded and

it was noted that some gave positive hemagglutination tests.

The remaining two samples, collected 20 feet from the crowd during basketball games on January 16 and 17, 1948, produced hemagglutinins in egg fluid.

The January 16 sample underwent numerous manipulations (Table 2). Weak hemagglutinins showed in the first and second allantoic passages. Second-passage allantoic fluid was inoculated intranasally into anaesthetized mice which were killed with ether 4 days later. One mouse showed a small, sharply delineated area of purple consolidation in one lung. One of a second group of mice inoculated from this lung died 48 hours later with lungs almost completely consolidated. A control mouse that also died had a diarrhoea and marked liver lesions. A third mouse passage yielded one mouse with a very slight lung lesion. This experience paralleled a previous one where the agent was lost on the third mouse passage. This time, therefore, the extraction from the second-passage mouse lung was inoculated also into eggs by allantoic and amniotic routes. Both types of egg fluids, positive for hemagglutinins, were pooled and reintroduced into eggs. Allantoic material from this passage gave weak hemagglutinins but the amniotic fluids were strongly positive. Further amniotic passage yielded viscous fluids, some of which were positive and all of which hemolyzed the test erythrocytes. A series of amniotic fluids from uninoculated eggs at this time also showed weak hemagglutinins and hemolyzed the test erythrocytes. Tests showed that the hemolysis could not be attributed to the reagents nor to the glassware used. These egg fluids were therefore discarded. The remainder of the positive fluids resulting from inoculation with the second-passage mouse lung was then given three serial allantoic passages. The first two were negative, but the third was positive and bacteria-free. These materials were inadvertently discarded before agglutination-inhibition tests with influenza antisera could be done.

The remaining materials that had been stored for two to five months at 5° C. consisted of pools of fluid that had given very weak hemagglutination tests, the negative fluids from the "blind" allantoic passages, part of the second-passage mouse lung, and the third-passage mouse lung. These were all given three or four serial allantoic passages but no hemagglutinins were elicited. They were also re-examined for the presence of the pleuro-pneumonia-like bacteria reported in egg fluids by Van Herick and Eaton (1945). No contaminants were detected.

The air sample of January 17, as far as it was investigated, behaved like that of January 16. The positive mouse of the single mouse passage showed ruffled fur and labored breathing at the end of 72 hours and was killed lest it die during the night. The lungs showed marked consolida-

TABLE 2. Results of Attempted Cultivation of Hemagglutinating Agents from Air Samples

		Hemagglutination tests on individual egg fluids*											
	Animal No.:	1	2	3	4	5	6	7	8	9	10	11	12
Sample of 12-16-47. 98.9 cu. ft.		+	+	+	+	0	0	0	0	0	0	0	0
Allantoic inoculation. 13-day embryos.		db	db	db	b	b							
	Allantoic inoculation in 12-day embryos												
12-23-47.	Second passage. Positive fluids of 12-16-47 pooled and 100,000 units of penicillin added.	2+ db	2+ db	2+ db	2+ db	2+ db	0 db	0 db	0 db	0 db	0 db	0 db	0 db
1- 6-48.	Third passage. Positive fluids of 12-23-47 pooled and Seitz-filtered.	1+ db	1+ db	± db	± db	± db	0 db	0 db	0 db	0 db	0 db	0 db	0 db
1-13-48.	Fourth passage. Positive fluids of 1-6-48 pooled and passed through a Selas filter.	± d	0	0	0	0	0	0	0	0	0	0	0
1-21-48.	Fifth passage. ± fluid of 1-13-48.	0	0	0	0	0	0						
Sample of 1-16-48. 103.2 cu. ft.		4+	2+	±	0	0	0	0	0	0	0		
	Allantoic inoculation 12-day embryos.	p	p	d	d	p	p						
1-23-48.	Second passage. Positive fluids of 1-16-48 pooled. Allantoic inoculation.	3+	±	0	0	0	0						
1-29-48.	Third passage. Positive fluids of 1-23-48 pooled and inoculated into four mice one of which showed lesions. Control mice inoculated with sterile allantoic fluid were negative.												
3-22-48.	Positive mouse lung of 1-29-48 ground in sand and 5 ml. physiological saline. Penicillin added to supernate to make 10,000 units/ml. Inoculation of five mice resulted in one showing lesions, death ensued.												
	Allantoic inoculation	0	0	0	0	0	0						
	Amniotic inoculation	±d	±d	±	0	0	0						
3-24-48.	One-half of positive mouse lung of 3-22-48 ground and treated with penicillin as before. Inoculations of five mice resulted in one showing a small lesion.												
	Allantoic inoculation	3+	2+	2+	1+	±	±	0	0	0			
	Amniotic inoculation	3+	2+	±	0	0	0	0					

3-29-48.	3+ and 2+ fluids of 3-24-48 pooled.											
	Allantoic inoculation, undiluted fluids	2+	±d	0	0	0	0					
	Allantoic inoculation, fluids diluted 10^{-1}	0	0	0	0	0	0					
	Allantoic inoculation, fluids diluted 10^{-2}	0	0	0	0	0	0					
	Amniotic inoculation, undiluted fluids	3+ d	3+ d	2+ d	0	0	0					
4-6-48.	3+ and 2+ fluids of 3-24-48 pooled (repeat on inoculation of 3-29-48). Amniotic inoculation. Control eggs were uninoculated, but amniotic fluids were tested and found negative.	4+	4+	3+ d	3+	3+	3+	1+ p	±	0	0	0	0
4-14-48.	4+ and 3+ fluids of 4-6-48 pooled. 13-day embryos. Control eggs uninoculated.											
	Allantoic inoculation	±	±	0	0	0	0	0	0				
4-22-48.	3+ and 2+ fluids of 3-24-48. Allantoic inoculation.	1+	0	0	0	0	0					
4-26-48.	1+ fluid of 4-22-48. Allantoic inoculation. 11-day embryos.	0	0	0	0							
	Pooled negative fluids of 4-22-48. Allantoic inoculation.	0	0	0	0	0						
5-4-48.	Pooled negative fluids of 4-26-48. Allantoic inoculation. 12-day embryos. 3-day incubation.	4+	3+	3+	1+	1+	0					
Sample of 1-17-48.	148.9 cu. ft.	3+	±	±	0	0	0	0	0	0	0	
	Allantoic inoculation. 12-day embryos.	p	dp	p	p	p						
1-23-48.	Second passage. Positive fluids of 1-17-48 pooled. Allantoic inoculation.	3+	1+	±	0	0	0					
1-29-48.	Positive fluids of 1-23-48 pooled and inoculated into mice. One, moribund in 72 hrs., showed lesions.											

* 4+ = uniform layer of agglutinated erythrocytes over bottom and adjacent sides of tube; 3+ = large coarse aggregates covering bottom of tube; 2+ = central disc of cells surrounded by large coarse aggregates; 1+ = like 2+ but less marked; ± = button of red cells with pale ragged edges; 0 = button of red cells with smooth sharp edge.
d = dead in 24-48 hours with respect to eggs; b = contaminated with bacteria; db = dead and contaminated with bacteria; p = flocculent precipitate in fluid.

tion of the kind considered to be characteristic of influenza. After five months' storage in glycerine-saline at 5°C. these lungs failed to produce hemagglutinins in eggs.

Dust. All dust samples that showed hemagglutinins were contaminated with diptheroids and/or other bacteria so that no work with respect to virus content was done. Penicillin plus crystalline sodium sulfathiazole, crystalline sulfanilamide, Zephiran 1:20,000, and merthiolate 1:200 were ineffective against these contaminants. Tyrothricin, 0.05 per cent, controlled the diptheroids in two trials, but its effect on virus was not determined.

Controls. The hemagglutination tests for control materials were all sharply negative except where bacteria or albumin were present.

TESTS FOR HERPES SIMPLEX VIRUS

No lesions resembling those caused by the neurotropic strain used in preliminary experiments were seen. Most of the chorioallantoic membranes, including those inoculated with control materials, showed the signs of non-specific irritation detailed by Scott (1948). In addition, membranes inoculated with samples showed irregularly-shaped, thickened, opaque areas covering the site of inoculation. One set of bacteria-free membranes, showing unusually marked lesions, was removed from the eggs, ground with sand and physiological saline, and inoculated onto a second series of egg membranes. No reproduction of the lesions occurred in this second passage. Representative membranes that had been stored in 1:1 glycerine-saline at 5°C. for periods of time ranging from six weeks to three months were ground in physiological saline and injected intracerebrally into mice with negative results.

It is possible that the membrane lesions were non-specific because the sample inoculum, in contrast to the control inoculum, often had approximately twice as high a salt concentration (because of evaporation of the sampling broth) and also contained much particulate matter. On the other hand, the long storage period and the use of saline diluent might have prevented survival of any virus present.

DISCUSSION

A hemagglutinating agent capable of serial passage in embryonated eggs and of producing influenza-type lesions in mouse lungs was obtained from the air of a crowded gymnasium. It does not appear that it could have had any other origin. The possibility that it was a laboratory contaminant seems remote because the only strain under cultivation at the time this work was in progress was the egg-adapted PR-8 virus. The air-borne entity was difficult to establish in eggs. The latent mouse lung viruses so far reported do not agglutinate chicken erythrocytes.

In the absence of agglutination-inhibition tests with appropriate antisera, it cannot be claimed that the agent actually was influenza virus. However, these findings indicate that a direct approach to the problem of the mode of spread of respiratory diseases of virus origin is possible.

The idea that herpes simplex virus might be useful as an indicator of salivary air pollution gained no support in this investigation. Since the completion of this work the behavior of salivary herpes simplex virus on the chorioallantoic membrane has been studied (Coriell *et al.*, 1949). Previous investigations of the occurrence of herpes simplex in saliva of normal individuals have been carried out in animals and the results so far are not entirely conclusive (van Rooyen and Rhodes, 1948). Another investigation of this problem using embryonated eggs might yield information that would indicate whether studies on air-borne herpes simplex virus can be profitably undertaken.

ACKNOWLEDGMENTS

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SUMMARY

Samples of air averaging 186 cu. ft. were collected on thirteen different occasions in a crowded gymnasium by a method shown not to inactivate entrapped virus, and cultivated in embryonated eggs to detect the presence of influenza and herpes simplex viruses. On two occasions a bacteria-free hemagglutinating agent capable of serial egg passage and producing typical influenzal lesions in mouse lungs was detected. No evidence for the presence of herpes simplex virus was obtained.

Floor sweepings collected concomitantly with the air samples could not be examined because of heavy bacterial contamination.

These findings, while not conclusive, encourage a direct approach to the problem of the mechanism of the spread of respiratory tract virus infection.

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Triethylene Glycol in the Control of Air-Borne Dissemination of Pneumoencephalitis (Newcastle Disease)

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During the past few years considerable attention has been given to developing methods of air sterilization. Glycol vapors have been tried and have been reported highly effective not only in the control of air-borne infection due to bacteria and fungi, but also in the control of diseases due to filtrable viruses, including colds in humans (Robertson 1941, 1942 and 1943; Harris and Stokes 1945).

It has been demonstrated by DeLay and others (1948) that the virus of pneumoencephalitis (Newcastle disease) is air-borne, and that air from poultry houses containing birds affected with this disease will infect chick embryos, and that materials from these will in turn produce the disease in chicks. Moreover, Krugman and Swerdlow (1949) have recently found that triethylene glycol has a lethal effect on the Newcastle disease virus when exposed in a specially constructed chamber.

Since the virus that causes this disease is air-borne it was decided to determine if triethylene glycol vapors were effective in preventing its spread from affected to well birds in a room with forced draft ventilation. If glycol vapors were found to be effective in the control of this virus, practical application in hatcheries and broiler plants would be of considerable importance to the poultry industry.

EXPERIMENTAL PROCEDURE

These experiments were conducted in a room 8 feet by 12 feet, by 8 feet high with a concrete floor and a ceiling of Johns-Manville one-half inch thick insulating board. Forced draft ventilation was produced by a fan in the attic attached to an eight-inch diameter flue in the ceiling. This was provided with an air filter at its entrance into the room. Intake of air was provided through a center shaft in the building from a louvered cupola and gained access to the room through an opening beneath the door approximately three by 36 inches. See figure 1.

The first four experiments were conducted by using a small Vapor Roll Vaporizer obtained from The Health Equipment and Service Corporation, Silver Spring, Maryland. The other two were conducted by using a larger vaporizer, Model ARA-4, obtained from the same concern.

In each experiment, except the first, the susceptible well birds were kept in wire cages placed on a metal stand 30 inches high and the inoculated birds were kept on the floor, which was of heavy meshed wire raised about six inches above the concrete floor. The placing of the stand containing the cages with relationship to the position of the vaporizer varied so that at least three different positions in the room were tried during the course of the experiments. The relative humidity in all these

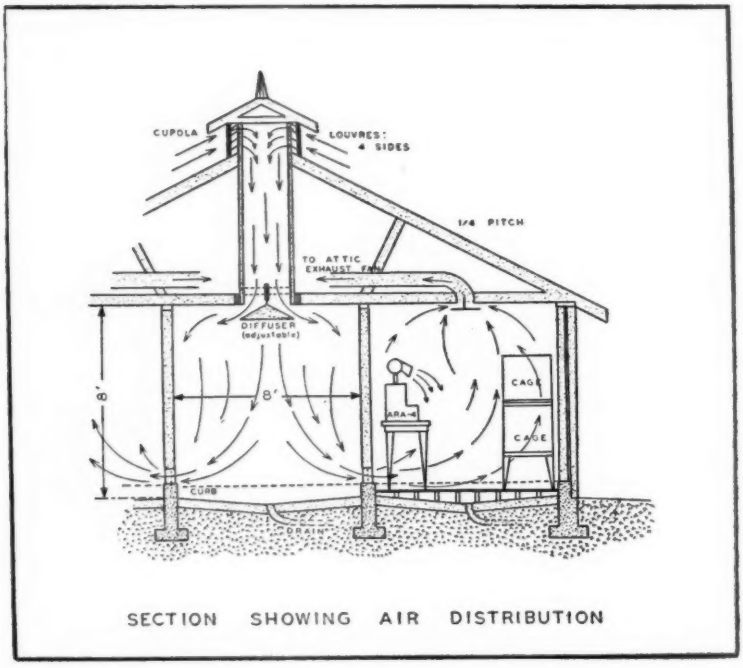


Figure 1

experiments was within the ranges of 20 and 50 per cent.

Experiment 1. This experiment was started on November 13, 1948, when 15 New Hampshire Red chickens, 53 days of age, were placed in the room which has been described. A sample of pooled sera from five of these was negative on this date to the hemagglutination-inhibition test. On November 24, 1948, another pooled sample of sera from five of the chickens was negative to the H-I test. At this time the small Vapor Roll

Vaporizer mentioned above was placed in operation on the metal bench in the room as described above, and six of the chickens of the same group were inoculated intranasally with a potent strain of Newcastle disease virus[1] and placed on the floor in this room with the other birds. The vaporizer was operated on a speed sufficient to maintain fogging of the glass in the windows and door. The results were briefly as follows: Four of the six inoculated birds developed paralysis and nervous symptoms, typical of the disease, between November 28 and December 7. Three of these died. Six of the fifteen uninoculated birds developed similar symptoms between November 30 and December 7, when the experiment was terminated. Two of these died. This was approximately 66⅔ per cent infection in the inoculated group and 40 per cent infection in the controls.

Experiment 2. This experiment was started on January 7, 1949, when 18 White Leghorn chickens, 57 days of age, were placed in six metal cages on the metal stand in the room which had been thoroughly cleaned and washed previously. A pooled serum sample from three of these chickens gave a negative H-I titer on this date. On the same day eight chickens from the same source were inoculated intranasally with 0.05 ml. N_2 virus, placed on the floor in this room and the Vapor Roll Vaporizer placed in operation. The bench containing the cages of uninoculated birds was placed opposite the glycol vaporizer in this experiment. The results were as follows: All eight of the inoculated birds on the floor developed symptoms of paralysis and nervous disturbances typical of Newcastle disease. The first bird developed symptoms on January 11, and the last in this group on January 13. Four of these died. Five of the 18 uninoculated birds in the cages became infected and three of these died. The experiment was terminated on January 15. It may or may not be significant that no bird of the six in the two end cages near the wall and farthest away from the vaporizer became infected. This resulted in 100 per cent infection in the inoculated birds and 27 ± per cent infection in the controls.

Experiment 3. This was started on February 4, 1949, when 12 White Plymouth Rock chickens, 85 days of age, were placed in cages as described in the previous experiment. On the same day eight chickens from the same group were each inoculated intranasally with 0.05 ml. of N_2 virus and placed on the floor of this room and the small vaporizer placed in operation. On February 8, 1949, it was noted that the vaporizer was not operating properly and in this experiment there were intermittent periods when vapors were not evolved. The experiment was terminated on February 8, at which time four of the inoculated birds were

1 The California strain No. 11914 which produces marked nervous symptoms and is referred to in this paper as N_c.

paralyzed and four of the uninoculated birds in the cages on the stand were paralyzed. At this point the results appeared discouraging to us and it seemed that we had proved only one point: that Newcastle disease virus is definitely air-borne and spreads readily by this method from infected to susceptible birds.

Since the vaporizer had not operated correctly we obtained a new machine of the same type and from the same source for our next trial.

Experiment 4. This was started on February 21, 1949, when 12 White Leghorn chicks, 82 days of age, were placed in six cages on the stand in this room, the room having previously been thoroughly washed and disinfected. The new vaporizer seemed to be operating correctly and there was fogging of the glass in the door and windows at all times. On the same date five chickens of the same group were inoculated with the N_2 virus as previously described and placed on the wire floor. The results were as follows: All of the five inoculated chickens on the floor became paralyzed and died between February 24 and March 1. One uninoculated bird in the cages became paralyzed and died on March 2. The experiment was terminated on this date because of extremely cold weather which brought the room temperature down to 40 degrees F. The final outcome was 100 per cent infection in the inoculated birds and 8 $\pm$ per cent in the controls.

Experiment 5. This experiment was started on May 2, 1949, and a new vaporizer of much greater capacity, and equipped with a blower, was used. This is Model ARA-4, made by Air Purification Service, Inc. The concentration of triethylene glycol released was sufficient to maintain a slight fog at all times.

Ten Barred Plymouth Rock chickens, 69 days of age, and nine New Hampshire Red chicks, 27 days of age, were placed in six cages on a metal stand to control the effectiveness of the glycol vapors in preventing the air-borne spread of Newcastle disease in the room previously described. The hemagglutination-inhibition test on pooled serum from three of these birds was negative at the time the birds were placed in the cages. On the same day nine similar Barred Plymouth Rock chicks were inoculated with N_2 virus and placed on the floor and the vaporizer placed in operation as previously described. The results were briefly as follows: Five of the nine birds on the floor became paralyzed and four of these died. Eleven of the 19 birds in cages became paralyzed and three of these died. The cages were arranged as indicated in the diagram. As there was very little evidence of infection in the top cages it appears that the air currents carried the glycol past the lower cages. The stand containing the cages was placed directly opposite the air inlet under the door. In studying this situation it appears that the suction of air from

the ceiling fan directed the air currents so that proper saturation of glycol vapor was prevented from reaching the lower cages.

CAGE ARRANGEMENT

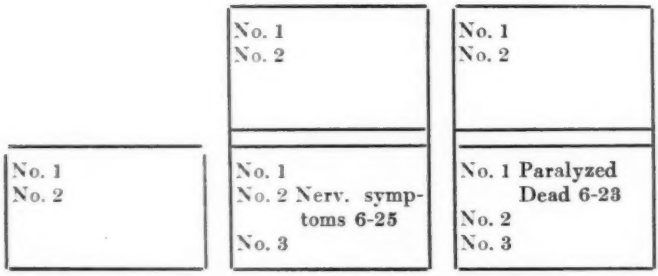
EXPERIMENT 5

69-day-old Barred Rocks No. 1 Droopy 5-14 Par. 5-15 No. 2 No. 3	69-day-old Barred Rocks No. 1 Par. 5-15 No. 2	27-day-old N. H. Reds No. 1 No. 2 No. 3 No. 4
69-day-old Barred Rocks No. 1 Par. 5-14-49 No. 2 Par. 5-14-49 No. 3 Par. 5-17-49	27-day-old N. H. Reds No. 1 Par. 5-7 Dead 5-9 No. 2 Dead 5-11 No. 3 Par. 5-15 No. 4 Nerv. symptoms head and neck 5-16 No. 5	69-day-old Barred Rocks No. 1 Par. 5-10 Dead 5-12 No. 2 Par. 5-12

Experiment 6. This experiment was conducted similarly to the previous one except that the cages containing the uninoculated birds were placed in the opposite end of the room as far away from the vaporizer as the room would permit. A baffle was placed in front of the opening beneath the door to break up the air currents and, in this way, insure the proper saturation of glycol vapor throughout the room. The vaporizer was also operated in the room 36 hours before the inoculated birds were placed in the room, which was a variation from the previous procedures. Thus, on June 14, twelve six-week-old New Hampshire Red chickens were placed in cages as controls on the effectiveness of the glycol vapors. On June 15, nine from the same group as those above were placed on the floor. Seven of these were inoculated intranasally with 0.05 ml. N_2 virus before they were released on the floor. Of the birds in the cages, one developed nervous symptoms on June 25, and another became paralyzed and died on June 23. Both of these were in the bottom tier of cages as indicated in the diagram below.

CAGE ARRANGEMENT

EXPERIMENT 6



Three of the inoculated birds on the floor became paralyzed and one died, and one of the uninoculated birds became paralyzed. On June 27, the glycol vaporizer was turned off, and on June 28, two more similar birds were inoculated with N_2 virus and placed on floor. The experiment was concluded on July 7, and up to that time there was no further evidence of infection in the cages although the inoculated birds became paralyzed and one died.

From the preceding experiments it appeared to us that triethylene vapors would protect birds from infection with the Newcastle virus if the vapors were released so that they would come directly in contact with the birds.

TRIETHYLENE GLYCOL UNDER PRACTICAL CONDITIONS

Our next experiments were conducted in cooperation with a broiler grower in order to determine what would happen to broiler chicks in colony houses under practical conditions when exposed to Newcastle disease virus in the presence of triethylene glycol vapors.

Experiment 7. In this experiment three small colony houses approximately 12 x 14 feet were used. Each house contained fifty, four-week-old, chicks from which a pooled blood sample drawn from four chicks in each group was negative to the hemagglutination-inhibition test for Newcastle disease. The large glycol vaporizer, referred to in the previous experiment, was placed on an inverted barrel so that the vapor was released approximately 6 feet from the floor in one of the houses. The windows were left open and the care of the chicks was similar to that practiced by the best broiler growers in that vicinity. This experiment was started on August 4, 1949, when 10 chicks in the house containing the glycol vapors were inoculated intranasally with .05 ml. each

of the N_2 virus. In one of the other houses 10 chicks were inoculated similarly. The third house was used as a control and no glycol was used and no chicks were inoculated.

The results indicated definitely that the glycol vapors were not getting in contact with the chicks with the vaporizer in this position. Approximately an equal number of birds came down with Newcastle disease in both houses that contained inoculated birds. There was no indication of the disease in the control house.

Experiment 8. At this stage we decided to run an experiment in which the glycol vapors would be released into ducts that entered each room so that the vapors were released near the floor. The houses were thoroughly cleaned and disinfected as well as fumigated with formaldehyde at the outset. Two houses were used. The one which contained the control birds where no glycol was used was a colony house 12 feet by 14 feet. The other, in which the triethylene glycol vapor was used, was a colony house 16 feet by 32 feet. This was divided into two equal rooms with a partially closed partition between the two. A watering trough was placed in the partition so that it could be used by both groups of birds. The vaporizer was hung near the ceiling in one room and four inch galvanized iron ducts carried the vapors into each room so that they were released about twelve inches from the floor. See figure 2. The experiment was started on October 17, 1949, when the vaporizer was operated about four hours before the chicks were placed in the house. Fifty chicks, four and five weeks of age, were placed in each room receiving glycol vapors and 98 similar chicks were placed in the control house. A pooled blood sample from three chicks from each lot was negative to the H-I test on the day the experiment was started.

In the south half of the house containing the glycol vapor, as indicated in figure 2, no chicks were inoculated with N_2 virus. In the north half, however, ten chicks were inoculated intranasally with N_2 virus and about one ml. of the virus remaining in the syringe was squirted on the litter in this room. The objective was to learn if triethylene glycol would prevent infection of the chicks in the south half of this house under these conditions. No chicks in the control house were inoculated at this time. The results were briefly as follows: On October 26, one chick in the control house died. Another died on October 28. Both had respiratory symptoms but no diagnosis was made on these.

In the south half of the house with glycol vapors and which contained no inoculated chicks, one died on October 22. This was due to an internal hemorrhage as the result of cardiac puncture for a blood sample.

In the north half of the house with glycol vapors and which contained inoculated chicks, one died on October 21, as the result of hemorrhage due to cardiac puncture. Several of the inoculated chicks had symptoms of Newcastle disease and two were still manifesting nervous-

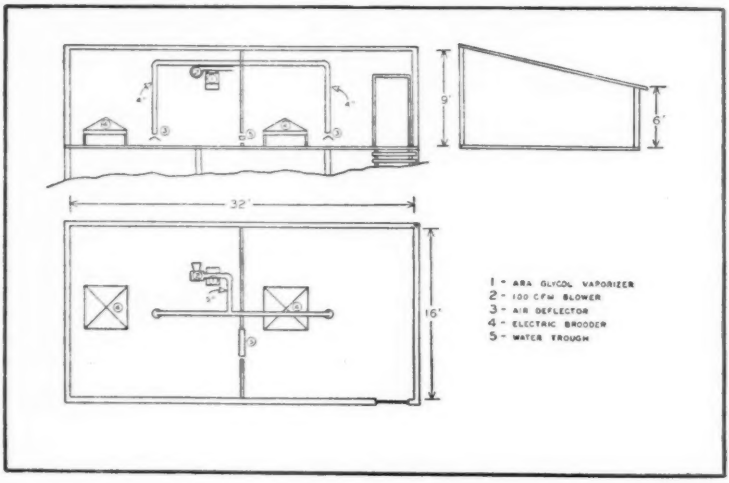


Figure 2

ness on November 4. Three uninoculated chicks in this room had nervous symptoms and one died of Newcastle disease on the same day.

On November 4, or 18 days after starting the experiment, it was decided to obtain blood samples from four chicks in each lot to learn if there was any response to the virus in the control house and in the uninoculated room containing glycol vapor. All samples were H-I positive. Since there were only three birds in the control house and one bird in the uninoculated room with the glycol vapors that had symptoms of Newcastle disease it was decided to challenge several birds to learn if they were immune. Ten birds in each of the two lots were challenged intranasally with N_2 virus and some live virus was squirted on the litter as was done in the inoculated room at the start of the experiment. The results on November 19, when the experiment was terminated, were as follows: In the control house one chick died on November 7, with Newcastle disease. On November 19, there were 23 chicks with nervous symptoms typical of the disease, and the general condition of this group

was unthrifty and inferior. In the south half of the house with glycol in which the birds were challenged on November 4, there was only one chick with slight nervous symptoms. There were 47 chicks which appeared to be in good health.

In the north half of the house with glycol vapors there was, likewise, only one chick with nervous symptoms on November 19. The others in this room were in good health including the five that had nervous symptoms on November 4. This group appeared much superior to the controls. The birds in the house with glycol vapors averaged 0.4 pounds per bird heavier than the birds in the control house at the time the experiment was terminated.

SUMMARY

Six experiments were carried out in a room with forced draft ventilation to determine the effectiveness of triethylene glycol vapors in the prevention of air-borne infection of chickens with the Newcastle disease virus. In the first four experiments a small Vapor Roll Vaporizer was used and in the others a larger vaporizer with a blower (Model ARA-4) was used. The results were not successful in the first five experiments. In the sixth experiment, however, when the position of the cages containing the birds to be protected was moved farther away from the vaporizer, and a baffle was placed in front of the opening beneath the door to direct the vapors toward the cages, the results were much better with only two birds in the cages becoming slightly affected.

In two experiments carried out in colony houses under practical conditions the results were favorable only in the one experiment where a duct was used to release the vapors about 12 inches above the floor as they were blown from the vaporizer by the aid of a fan. From these experiments it may be concluded that if triethylene glycol vapors are released so that they come in direct contact with the birds and in sufficient concentration to create a slight fog in the room, under conditions of approximately 20 to 50 per cent relative humidity, they will prevent air-borne infection with Newcastle disease virus to a high degree.

ACKNOWLEDGMENTS

The author gratefully acknowledges the assistance given by Dr. S. B. Hitchner, now at the University of Massachusetts, in conducting the first five experiments; the splendid cooperation of Mr. Ralph M. Hoover, Timberville, Virginia, who kindly made available the chicks and the houses used in the last two experiments and, finally, the assistance of Mr. F. A. Hollomon of the Health Equipment and Service Corporation, Silver Spring, Maryland, for furnishing and installing the vaporizer equipment used in these experiments.

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News and Notes

(Editor's note: News contributions should be sent to the person whose name appears at the end of the appropriate section.)

NEWS FROM THE PRESIDENT

Boyd Harshbarger, Academy president, and Foley F. Smith, Secretary-Treasurer, represented the Academy at the Academy Conference held in connection with the American Association for the Advancement of Science meetings in New York during December. At these meetings Dr. Harshbarger was elected president of the Academy Conference for the year 1950. The meeting of the next Academy Conference, which is composed of forty-one state academies, will be held in Cleveland during the last week in December. In this capacity he is communicating with the various state academies and is giving special attention to the formation of collegiate chapters. President Harshbarger also represented the Academy at the inauguration of Dr. H. Sherman Oberley, President of Roanoke College, on April 14, 1950 and the inauguration of Dr. Orville Wake, president of Lynchburg College on April 25, 1950.

Walter S. Flory represented the Academy at the inauguration of Dr. Warren D. Bowman, president of Bridgewater College, on March 25.

—BOYD HARSHBARGER, VIRGINIA POLYTECHNIC INSTITUTE

PROPOSED CONSTITUTION AS REVISED*

ARTICLE 1 NAME

The name of the organization shall be The Virginia Academy of Science.

ARTICLE 2 PURPOSES

The purposes of this organization shall be as follows:

1. To encourage scientific research in Virginia and to arouse interest in and appreciation of science among the people of the State.
2. To discover, encourage and develop scientific interest and ability among the youth of the State by a Junior Academy of Science, by science clubs, by science talent searches and by other means.
3. To facilitate prompt publication of acceptable scientific papers and abstracts.
4. To cooperate insofar as practicable with industries in their scientific problems and with other scientific organizations having aims similar to this organization.
5. To cooperate with those in charge of the Virginia State Science Museum and the Virginia Institute for Scientific Research.
6. To render public service in scientific matters.

* Revised from Constitution adopted at Danville Meeting, May 4-6, 1939 (Academy Proceedings, 1938-1939, page 68)

7. To hold meetings of the Junior and Senior Academies for the better prosecution of these purposes and to further better acquaintance of those interested in all branches of science in Virginia.

ARTICLE 3 MEMBERS

Section 1. There shall be seven classes of members: regular, student, contributing, sustaining, life, patron, and honorary life.

Section 2. Regular members shall consist of persons who are interested in any of the purposes of the organization. Annual dues of regular members shall be three dollars ($3.00). A regular member in good standing must not be in arrears in dues for more than one year.

Section 3. Student members shall consist of undergraduate students in the colleges or universities of the State. Their dues shall be one dollar ($1.00) a year and they shall have all the rights and privileges of regular members excepting they shall not receive its official publication, *The Virginia Journal of Science*. A student member in good standing must not be in arrears in dues for more than one year.

Section 4. Contributing members shall consist of members who pay annual dues of five dollars ($5.00). A contributing member in good standing must not be in arrears in dues for more than one year.

Section 5. Sustaining members shall consist of members who pay dues of ten dollars ($10.00). A sustaining member in good standing must not be in arrears in dues for more than one year.

Section 6. A regular, student, contributing or sustaining member not in good standing because of non-payment of dues may be reinstated upon payment of dues in arrears.

Section 7. Subscriptions to the Academy's Journal will be discontinued for those regular, contributing and/or sustaining members who have not paid their dues by January 1 of each fiscal year. All members but student members shall receive the Journal.

Section 8. Life members shall consist of members who by paying the sum of one hundred dollars ($100.00) are exempt from payment of further dues.

Section 9. Patrons shall consist of those persons who have given to this organization the sum of one thousand dollars ($1,000.00) or its equivalent in property. They shall have all the rights and privileges of regular members and shall be exempt from dues. An institution may also become a patron by meeting the above requirement. Its representative shall have all the rights and privileges of regular members.

Section 10. Honorary life members shall consist of persons elected by the Council for long and distinguished service to science in this organization and others no matter where located. They shall have all the rights and privileges of regular members and shall be exempt from dues.

ARTICLE 4 ELECTION OF MEMBERS

Members of all classes excepting honorary life must be accredited by the Secretary-Treasurer of the Academy and/or the Council. See Article 3, Section 10, concerning honorary life membership.

ARTICLE 5 OFFICERS

The officers of this organization shall consist of a President, a President-Elect and a Secretary-Treasurer.

ARTICLE 6 DUTIES OF OFFICERS

Section 1. The President shall be the directing head of this organization and shall perform the usual duties of this office. He shall appoint the members of the standing committees and of any new committees authorized by the Council.

Section 2. The President-Elect shall assist the President as mutually agreed upon between them. He shall serve as President in the latter's absence.

Section 3. The Secretary-Treasurer shall receive and disburse all funds of this organization and shall submit at the annual meeting a written report of all receipts and disbursements. His report must be accompanied by an audit by a recognized public accountant. The Secretary-Treasurer shall be adequately bonded. He shall keep a complete record of each annual meeting, and of other meetings held during each year by the Council, and shall prepare a report of their proceedings for publication. The Secretary-Treasurer shall receive as yearly compensation for his services a sum designated by the Council.

Section 4. Officers of this organization shall be ex-officio members of all committees.

ARTICLE 7 COUNCIL

The executive body of this organization shall be known as the Council (Trustees). It shall be composed of the President, the President-Elect, the Secretary-Treasurer, the three most recent Past Presidents, the Editor and Technical Editor of its Journal, and of five additional members all to be chosen from the membership. These additional members shall serve for five years in regular rotation, one being elected each year and one retiring each year. In the case of death or other unfore-

seen interruptions of this routine, the President shall make interim appointments until the next annual election is held. A Past President shall serve for three consecutive years on the Council thus making his full term a total of five years. The Editor and Technical Editor shall serve on the Council as long as they continue in office.

ARTICLE 8 DUTIES OF THE COUNCIL

The Council shall have charge of the policy of this organization and shall supervise the publication of its Journal, including the appointment of the Editor, Technical Editor, Assistant Technical Editor and Advertising Manager. The term of office of each shall be set by the Council.

ARTICLE 9 ELECTION OF OFFICERS AND COUNCIL MEMBERS

A Nominating Committee, appointed by the President, shall submit to the annual meeting nominations for President-Elect, Secretary-Treasurer, and for one or more members of the Council. Nominations from the floor shall be in order. These officers shall be elected annually by the membership and, with the exception of the Secretary-Treasurer, shall not be eligible to succeed themselves.

ARTICLE 10 SECTIONS AND AFFILIATED CHAPTERS

Section 1. Any group of members may, with approval of the Council, organize as a separate Section. Such a Section shall become established after it has conducted one successful program at an annual meeting. Any established Section which fails to conduct a program for two successive annual meetings may be dropped as a Section by action of the Council. Such a Section may be reestablished by the Council after it has conducted one successful program at an annual meeting. If any Section shall plan to adopt a constitution and by-laws, they must be approved by the Council prior to adoption by the Section.

Section 2. Any group of members may, with the approval of the Council, organize Affiliated Chapters wherever is deemed necessary. Each new Chapter's constitution and by-laws must be approved by the Council prior to its official affiliation with this organization.

ARTICLE 11 MEETINGS

The annual meeting of this organization shall be held on the first or second Thursday, Friday, and Saturday of May in each year at a place selected by the membership. The Council shall decide whether the annual meeting shall be held the first or second Thursday, Friday, and Saturday in May and shall arrange for any special meetings deemed necessary.

ARTICLE 12 BUSINESS

Section 1. Forty members of this organization shall constitute a quorum for the transaction of business at regular and special meetings. Seven members shall constitute a quorum for the transaction of business by the Council. No votes by proxy shall be cast at any meeting.

Section 2. The fiscal year of this organization shall be from April 1 to March 31.

Section 3. The parliamentary procedure of this organization shall be governed by Robert's Rules of Order, Revised.

Section 4. This constitution may be amended by two thirds vote of those members responding to a mail ballot sent to the entire membership provided such amendment shall have been introduced in writing at a previous regular meeting, and due notice of proposed change shall have been given in writing to each member.

Constitution Revision Committee
JOHN N. BUCK
E. C. L. MILLER
SIDNEY S. NEGUS, Chairman

ADVISORY COUNCIL ON THE VIRGINIA ECONOMY

More than three hundred citizens are working on committees of the Advisory Council on the Virginia Economy in an attempt to determine the factors which have depressed Virginia's income levels below the national average and to find workable means of raising these levels. The specific areas covered by these committees include Agriculture, Business Financing, Education, Fisheries, Forestry, Health and Welfare, Industry, Labor Resources, Markets and Marketing, Mining, Population, Public Financing, Recreation, Scientific and Economic Research, Transportation, and Water Resources.

The Council consists of fifty-two persons, including seven executives of state departments, who were appointed by the Governor in July, 1947. Officers include Lloyd C. Bird, Chairman, J. Harvie Wilkinson, Jr., Vice-Chairman, and Raymond V. Long, Executive Secretary. With the formalization of the Council by the General Assembly in 1948, George B. Zehmer, Director of Extension of the University of Virginia, undertook the task of recruiting committee members and starting them on their work. When the pressure of University duties forced Dean Zehmer to resign, Charles F. Marsh, Professor of Economics and Business Administration and Chairman of the latter department at the College of William and Mary, assumed direction of the Council's activities when he accepted the post of Coordinator-Consultant for the year beginning September 1, 1949.

In a progress report submitted to the Advisory Council in December, 1949, outlining the accomplishments of the various committees in initiating various studies as well as the problems and difficulties which have been encountered, Dr. Marsh concluded:

> "... The prospects for ultimate success are bright. Most of the committees have completed that groping or fumbling stage which is inherent in democratic, cooperative consideration of any important problem, have developed well-organized work programs, and have taken steps to complete important segments of that program. All of them are working toward June 1, 1950, as a deadline for the completion of their reports on the present stage of the Council program. Before September 1, 1950, it is contemplated that a comprehensive report based upon these committee reports will be in the hands of members of the Council. . . ."

The findings of the committees and the recommendations of the Advisory Council are to be implemented first, by direct report to the Governor, and second, by public information through the press, magazine articles, a speakers' bureau, and the publication of significant reports either in complete form or in digests prepared for the general reader.

J. SHELTON HORSLEY AWARD

Subject to the counsel and advice of Section Officers as to details, the new plan is outlined below:

1. All papers (excepting those previously published) reporting original research by Academy members and presented at the May Meeting will be eligible for the Award.
2. The former practice of submitting papers directly to the Research Committee will be discontinued.
3. The Officers of each Section are requested to serve as advisors to the Research Committee:
   (a) All papers submitted for the Award to be forwarded (in duplicate) to the Secretaries of the Sections—not to the Research Committee.
   (b) The Officers of the Sections are requested to select additional papers which they deem prizeworthy.
   (c) All papers submitted, either by their authors for the Award, or designated by Section Officers as prizeworthy, to be forwarded (in duplicate) to the Research Committee, c/o Mr. Foley F. Smith, Box 1395, Richmond, Virginia, on or before April 22, 1950.

From the most highly meritorious papers, the Research Committee will do its best to make a fitting selection—H. RUPERT HANMER, 400 PETERSBURG TURNPIKE, RICHMOND

Announcing the
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SECTION NEWS

AGRICULTURE SCIENCE SECTION

H. L. Dunton, head of the Agronomy Department, Virginia Agricultural Experiment Station, Blacksburg, reports that W. H. Skrdla, Timothy Taylor, Roy Hames, J. A. Lutz, G. R. Mathews, W. C. White, and G. W. Gosdin have joined the Agronomy Department during the past year.

Mr. Skrdla and Mr. Taylor will devote their entire time to pasture and forage crop research at the Northern Virginia Pasture Research Station at Middlesburg. Mr. Hames will be in charge of handling the cattle on the grazing experiments conducted at the Pasture Research Station.

Mr. Lutz, cooperating with the Tennessee Valley Authority, is doing work primarily in the testing of phosphates.

In the Extension Department G. R. Mathews recently joined the staff as the tobacco specialist. Mr. White will do extension work in agronomy in the eastern territory of the state.

Mr. Gosdin has joined the teaching staff. He has the position formerly held by John Pendleton, who is now on leave completing work for his doctorate at Cornell.

John R. Havis joined the staff of the Department of Horticulture at Virginia Polytechnic Institute. Mr. Havis will conduct research work on vegetable crops and the use of herbicide sprays.

George E. Mattus has become a member of the staff of the Department of Horticulture and will be in charge of harvesting and storage research as it pertains to fruits and vegetables.

Wesley P. Judkins, who was formerly connected with the Ohio Agricultural Experiment Station, has been appointed Head of the Department of Horticulture at Virginia Polytechnic Institute.

Roy E. Moser, Jr. has joined the Department of Horticulture as Extension Specialist in Fruit and Vegetable Processing and By-Products.

A paper entitled "Correlation between leaf color, leaf nitrogen content, and growth of apple, peach, and grape plants" by Wesley P. Judkins and I. W. Wander was published in the January 1950 issue (Vol. 25) of Plant Physiology.—T. J. NUGENT, P. O. Box 2160, NORFOLK

ASTRONOMY, MATHEMATICS, PHYSICS SECTION

The December 1950 issue of the Journal of the Optical Society contains an article co-authored by M. A. Pitman of Madison College, entitled "A Frustrated Total Reflection Filter for the Infra Red."

Frank L. Hereford of the Physics Department of the University of Virginia presented a paper at the winter meeting of the American Physi-

cal Society held at Columbia University.

Leander McCormick Observatory reports that a photoelectric photometer for use with the 26-inch telescope is being constructed. This instrument will be used primarily for the establishment of accurate magnitude scales in at least two colors in certain regions of the sky. The instrument will also be available for the study of light variations of selected variable stars and for determining the polarization of starlight.

The University of Virginia was host to a meeting of the Fluid Dynamics Section of the American Physical Society during the last week in December. Over one hundred members of the Society were registered during the three days of the meeting. Among the papers presented was one by J. W. Beams, L .B. Snoddy, and E. E. Hackman of Rouss Physical Laboratory.

—I. G. FOSTER, VIRGINIA MILITARY INSTITUTE, LEXINGTON

CHEMISTRY SECTION

Professor Robert F. McCrackan, for 37 years a member of the Department of Chemistry of the Medical College of Virginia, is retiring this year. The Board of Visitors has named him Professor of Chemistry Emeritus.

The American Chemical Society was represented by Dr. John H. Yoe of the University of Virginia at the inauguration of George Tyler Miller as president of Madison College on December 10.

The Research Corporation has awarded $2000 to the Department of Chemistry of Randolph-Macon Woman's College. The grant will assist in the purchase of equipment for a research project conducted by the entire department under a renewed contract with the Office of Naval Research.

The Office of Naval Research has renewed a contract with the University of Richmond for research in organic chemistry. Two graduate students, Carl D. Lunsford and J. Lee Rush, are employed on this project, which is under the direction of J. Stanton Pierce.

The following papers were presented by chemists of the du Pont plant in Richmond during the last year. A. K. Cocke, R. Woodell, and N. P. Crowe presented "A Study of One-Step Conversion of Continuous Filament Rayon to Spun Yarn" at the Fiber Society Meeting in Lowell, Massachusetts. W. E. Roseveare described "A New Instrument for Measuring the Fatigue of Tire Cord" at the Fiber Society meeting in Clemson, South Carolina. Another paper by the same author, "Recent Aspects of Cellulose Structure," was presented at the Symposium on Wood Chemistry in Brooklyn, New York.

Papers published recently by members of the department of biochemistry, Medical College of Virginia, are the following:
J. C. Forbes, G. H. L. Dillard, W. B. Porter, and *Olga Petterson*, Frac-

tionation of Serum Cholesterol of Chickens, Proc. Soc. Exp. Biol. Med., 71:25.

Charles D. Cox, *J. C. Forbes*, and J. H. Woltz, Fungistatic and Bacteriostatic Studies on Some Alkynoic Acid, J. Amer. Phar. Assoc., 39:55.

Lynn D. Abbott, Jr., and *J. Doyle Smith*, Chemical Preparation of Homogentisic Acid, J. Biol. Chem., 179 (1):365.

Lynn D. Abbott, Jr. and G. Watson James, III, Effect of Vitamin B_{12} on the Urinary Phenol Fractions in Pernicious Anemia, J. Lab. Clin. Med., 35:35.

C. C. Clayton and C. A. Baumann, Diet and Azo Dye Tumors: Effect of Diet During a Period When the Dye is not Fed, Cancer Research, 9(10):575.

—WILLIAM E. TROUT, JR., BOX 168, UNIVERSITY OF RICHMOND

ENGINEERING SECTION

During the past year, the Virginia Polytechnic Institute Engineering Experiment Station has issued several publications. Some of these are:

Your Land, Surveys, Maps and Titles (Vol. 42, No. 3, March, 1949)

Graphical Methods as Applied to Extraction Problems (Vol. 43, No 1., Nov., 1949) Bull & Coli.

Dimensional Analysis (Vol. 42, No. 6, Sept., 1949) Murphy.

Directions for securing these bulletins and other bulletins of the Virginia Engineering Experiment Station may be obtained from the Bureau of Public Relations, Virginia Polytechnic Institute, Blacksburg, by asking for Bulletin No. 5, Vol. 42, July, 1949.

—D. H. PLETTA, VIRGINIA POLYTECHNIC INSTITUTE

PSYCHOLOGY SECTION

John N. Buck was appointed by the Governor to represent the Psychology Section on the Governor's Advisory Committee for the 1950 White House Conference on Children and Youth. This committee met in Richmond on January 16 and selected representatives of the State of Virginia to attend the national meetings in Washington.

Dr. Curt Bondy, who for the past several years has been professor of psychology and head of the Psychology Department at Richmond Professional Institute, has accepted the professorship of psychology and the directorship of the Psychological Institute at the University of Hamburg as a guest teacher. His address will be Bornplatz 2, Hamburg 13, Germany.

The undergraduate Psychology Club at the College of William and Mary is considering the formation of a chapter of Psi Chi, national psychology fraternity. The club at William and Mary is interested in knowing whether any colleges in the state now have chapters of Psi Chi.

A workshop of the H-T-P Test was offered by John N. Buck at

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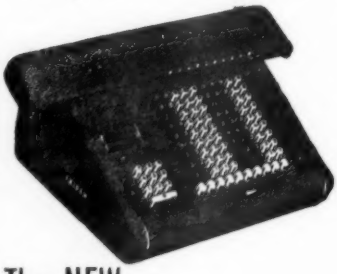

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the McGuire Veterans Administration Hospital, Richmond, on March 31 to April 2.

Recently a Motor Vehicle Fleet Supervisors' Course was given at the University of Virginia. Carl G. Seashore of the Institute of Public Safety of Pennsylvania State College, directed the course of instruction. Richard H. Henneman of the University of Virginia participated in the course.

Research contracts in psychology for the Navy and Air Force have recently been extended. Research for the Navy has centered around a systematic exploration of the sensitivity of the human skin to vibratory stimuli. The Air Force contract is concerned with a variety of human operator problems in aviation communication.

—RICHARD H. HENNEMAN, UNIVERSITY OF VIRGINIA

STATISTICS SECTION

C. F. Sarle is now in Turkey aiding the establishment of a Crop Reporting and Agriculture Statistical Service.

R. A. Bradley of McGill University, Montreal, Canada, visited the Virginia Polytechnic Institute Department of Statistics.

D. B. deLury is visiting lecturer at the U.S. Navy Electronics Laboratory, San Diego, California, where George M. Tyler is now associated.

Boyd Harshbarger and George M. Tyler attended the December meetings in New York of the American Association for the Advancement of Science.

Walter A. Hendricks, Boyd Harshbarger, Milton E. Terry and graduate students of the Virginia Polytechnic Institute attended the March meetings of the American Mathematical Society in Chapel Hill.

—MILTON E. TERRY, VIRGINIA POLYTECHNIC INSTITUTE

NOTES ON VIRGINIA PLANTS NOT PREVIOUSLY REPORTED FROM MASANUTTEN MOUNTAIN AREA

Equisetum sylvaticum var. *multiramosum* Fern.

Bog in northern end of Little Fort, Shenandoah County, Virginia, July 3, 1948.

Collected at an earlier date from this locality by C. O. Handley, Jr., V.P.I.

Stipa avenacea L. Four Stations

1. Dry woods, one mile south of Elizabeth Furnace Forest Camp, Powell's Fort, Shenandoah County, Virginia, May 23, 1948.
2. Dry woods, short distance north of Elizabeth Furnace, Powell's Fort, Shenandoah County, Virginia.
3. Dry woods, Harshbarger's Gap, Rockingham County, Virginia, June 7, 1949.
4. Dry woods, two miles northeast of Port Republic, Rockingham

(*Continued on page* 146)

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(*Continued from page* 145)

County, Virginia, in Blue Ridge area near Eastside Highway, June 8, 1949.

Melica mutica Walt.

Dry, rocky woods, near highway, short distance south of Elizabeth Furnace Forest Camp, Shenandoah County, Virginia, June 26, 1948.

Lilium canadense var. *editorum* Fern.

Rich soil along stream, Mooreland's Gap, Powell's Fort, Shenandoah County, Virginia, June 26, 1948.

Habenaria lacera (Michx.) R. Br.

Bog in northern end of Little Fort, Shenandoah County, Virginia, July 21, 1941.

Quercus bicolor Willd. Two stations.

1. Swamp. Woodstock Forest Camp in Little Fort, Shenandoah County, Virginia, August 30, 1939.
2. Sixteen or more trees of this species on Elizabeth Furnace Camp grounds where once there was a swamp. September 14, 1947.

LENA ARTZ
Waterlick, Virginia

Virginia Academy of Science

Program

OF THE

Twenty-eighth Annual Meeting

AT HOTEL ROANOKE

(MAY 11, AT ROANOKE COLLEGE)

ROANOKE, VIRGINIA

May 11, 12, 13, 1950

HOSTS: HOLLINS COLLEGE

ROANOKE COLLEGE

Virginia Academy of Science

OFFICERS

BOYD HARSHBARGER, *President*
E. C. L. MILLER, *Secretary-Treasurer Emeritus*
FOLEY F. SMITH, *Secretary-Treasurer*
GUY W. HORSLEY, *President-Elect*

COUNCIL

(Board of Trustees)

Elected Members

GILLIE A. LAREW (1950) ALLAN T. GWATHMEY (1952)
EDWARD S. HARLOW (1951) JOHN N. BUCK (1953)
LADLEY HUSTED (1954)

Ex-Officio Members

ARTHUR BEVAN (1950) JESSE W. BEAMS (1951)
SIDNEY S. NEGUS (1952)

LOCAL COMMITTEE ON ARRANGEMENTS

P. M. PATTERSON, *Chairman*
ASHLEY ROBEY, *Co-Chairman*
JOHN D. SCHUMACHER, *Section Rooms and Projection Equipment*
HARRIETT H. FILLINGER AND HERTA TAUSSIG, *Senior Registration*
T. H. GIBSON, *Junior Registration*
D. R. CARPENTER, *Junior Tours*
C. LUCIEN CROCKETT, *Senior Housing*
NELLIE MANGES, MRS. J. F. PRUFER, R. RUSH ANDERSON AND JAMES W. PRICE, *Junior Housing*
KENNETH HOOD, *Public Relations*
HELEN CHURCHILL AND C. H. RAYNOR, *Senior Exhibits*
C. H. RAYNOR, *Junior Exhibits*
CECILE FINLEY, *Senior Annual Dinner*
T. C. CAPRARO, *Junior Annual Dinner*
D. R. CARPENTER, *Guest Speakers*
LOUISE MADDREY, *Reception*
MOLLY T. DENTON, *Fifth Virginia Science Talent Search*
T. C. CAPRARO, *Junior Academy, Coordinator for Arrangements*

HOSTS TO MEETING

HOLLINS COLLEGE, BESSIE CARTER RANDOLPH, *President*
ROANOKE COLLEGE, H. SHERMAN OBERLEY, *President*

Announcements

INFORMATION CENTER

An Information Center to assist members and guests will be maintained by the local committee on arrangements near the registration desk in the lobby of the Hotel Roanoke. In addition on Thursday, May 11, an information center will be maintained in the Entrance Hall, Physics Building, Roanoke College.

JUNIOR ACADEMY OF SCIENCE

The Junior Academy of Science, under the leadership of Flood S. Andrews and B. N. Cooper, of the Virginia Polytechnic Institute, Co-Chairmen of the Academy Committee, will hold its own meeting at Roanoke College May 11. Members of the Junior Academy, those participating in the Virginia Science Talent Search and the Virginia Science Club Contests, and senior scientists who are interested in the activities of these juniors are urged to register beginning at 3 P. M. on Wednesday, May 10.

VIRGINIA SCIENCE TALENT SEARCH

All young scientists participating in the Virginia Science Talent Search are requested to report to P. C. Scherer, of the Virginia Polytechnic Institute, in Room 12, Lucas Chemistry Building at 10:30 A. M. on May 11.

In the National Science Talent Search, conducted by Science Clubs of America for the Westinghouse Science Scholarships, the following Virginia entrants received Honorable Mentions:

Betty Campbell Cook, Wilson Memorial High School, Staunton
Anne Louise Davis, Wilson Memorial High School, Staunton
John William Layman, Blacksburg High School, Blacksburg
Claire June Millhiser, Thomas Jefferson High School, Richmond
Camden Ballard Pierce, Thomas Jefferson High School, Richmond
Edward Carroll Smith, Huntington High School, Newport News

These young scientists and others participating in the Virginia Science Talent Search, Science Club Contest, and Individual Exhibit Contest will be honor guests of Roanoke College at 6:30 P. M., Thursday, May 11. Senior members and Juniors not participating in either the Science Talent Search, the Science Club Exhibit Contest, or the Individual Exhibit Contest should purchase tickets for the Junior Dinner at $1.50 at the registration desk at Roanoke College before 4 P. M., May 11. *Senior members are especially urged to attend this Junior Academy dinner in order to meet the young scientists.*

MEETINGS OF SENIOR MEMBERS ON THURSDAY, MAY 11

The meetings for seniors to be held at Roanoke College are:

1. The Council, 4:00 P. M., Room 25, Lucas Chemistry Building.
2. The Academy Conference and General Meeting, 8:00 P. M., Laboratory Theater.
3. The Section Officers, 5:00 P. M., Room 22, Lucas Chemistry Building.
4. The Editors, 3:00 P. M., Room 22, Lucas Chemistry Building.

LUNCHEON ON FRIDAY, MAY 12

A luncheon for members of collegiate chapters and other collegiate members will be held at 12:30 P. M. (see bulletin board for place). Tickets must be purchased before 10 A. M.

THE ACADEMY DINNER

Tickets for the Academy Dinner must be purchased before noon on Friday. The price of the tickets will be $3.50. Dinner will be served at 7:30 P. M. Dress will be informal.

EXHIBITS

The Academy will continue the sponsoring of commercial and educational exhibits.

RESEARCH COMMITTEE

H. Rupert Hanmer, Chairman of the Academy Rsearch Committee, has called a luncheon meeting of the committee for 12:30 P. M. on Friday, May 12, in the main dining room of the Hotel Roanoke.

MEMBERSHIP

Foley F. Smith, Chairman of the Academy Membership Committee, urges each member to invite teachers of science, those in scientific pursuits in industry, and laymen of broad interests in science to become members of the Academy. The dues are nominal and college students are eligible to membership at reduced rates. Mr. Smith will be available during the meeting at a desk near registration headquarters. Please aid the secretary-treasurer's office by paying your Academy dues for 1950-51 ($3.00) to Mr. Smith during the meeting.

FIELD TRIPS AND LAST-MINUTE CHANGES

Special announcements concerning field trips on Saturday afternoon, tours, and last-minute changes will be posted on a bulletin board near the Information Center in the lobby of the headquarters hotel.

General Program of the Twenty-eighth Annual Meeting

1950

WEDNESDAY, MAY 10, ROANOKE COLLEGE
SALEM, VIRGINIA

3:00 P. M.—Registration at the College for Junior Academy members and participants in the Science Talent Search, Entrance Hall, Physics Building.

THURSDAY, MAY 11, ROANOKE COLLEGE
SALEM, VIRGINIA

8:00 A. M. to 9:00 P. M.—Registration at the College for Junior and Senior Scientists and Guests, Entrance Hall, Physics Building.

8:00 A. M. to 9:00 A. M., May 12—Display of Science Exhibits, Rooms 1, 2, and 11, Physics Building.

10:30 A. M.—Participants in the Science Talent Search meet with P. C. Scherer in Room 12, Lucas Chemistry Building.

10:30 A. M.—Participants in the Science Exhibit Contest meet with F. S. Andrews and B. N. Cooper, Room 12, Physics Building.

11:00 A. M. to 4:30 P. M.—Judging of those entering the
(a) Science Talent Search, Rooms 7, 17, and 27, Lucas Chemistry Building.
(b) Science Exhibit Contests. Rooms 1, 2, and 11, Physics Building.

12:30 P. M.—Radio Program

1:00 to 6:00 P. M.—Registration of Senior Scientists at Hotel Roanoke for those not able to register at Roanoke College, Colonial Room.

2:00 P. M.—Annual Business Meeting of the Junior Academy of Science, Room 12, Lucas Chemistry Building.
Invited Lecturer: Professor Andrew Murphy, Roanoke College, "Chemistry as a Vocation".
Business Meeting.

3:00 P. M.—Meeting of the editors of the Virginia Journal of Science in Room 22, Lucas Chemistry Building.

4:00 P. M.—Meeting of the Council of the Senior Academy in Room 25, Lucas Chemistry Building.

5:00 P. M.—Meeting of the Officers of the Sections in Room 22, Lucas Chemistry Building.

6:30 P. M.—Junior Academy Dinner at Roanoke College, Commons Dining Room. Participants in the Science Talent Search and Science Exhibit Contests will be the guests of Roanoke College. Senior members are urged to attend this dinner. A charge of $1.50 will be made.

Presiding—Arthur R. Giesen, Jr., President of the Junior Academy.

Greeting—Boyd Harshbarger, President of the Academy.

Welcome—H. Sherman Oberley, President of Roanoke College.

Presentation of Junior Academy Awards—F. S. Andrews, B. N. Cooper.

Presentation of Virginia Science Talent Search Awards—P. C. Scherer.

Address—Walter S. Flory, Vice-Director, Blandy Experimental Farm of the University of Virginia, "Science and Technology".

8:00 P. M.—Panel Discussion for Juniors.

8:00 P. M.—Academy Conference and General Meeting, Laboratory Theater.

Presiding—Boyd Harshbarger, *President*

Reports of Officers

Reports of Committees

Constitution Committee—Sidney S. Negus, *Chairman*

By-Laws Committee

Long Range Planning—Lloyd C. Bird, *Chairman*

Research Committee—H. Rupert Hanmer, *Chairman*

Finance and Endowment—Guy W. Horsley, *Chairman*

Junior Academy of Science—F. S. Andrews and B. N. Cooper, *Co-Chairmen*

Speakers Bureau—Frank C. Vilbrandt, *Chairman*

Virginia Science Talent Search — P. C. Scherer, *Chairman*

Activities for Collegiate Members—Joe W. Guthridge, *Chairman*

Resolutions Committee—J. Gordon Stipe, Jr., *Chairman*

Exchange of Foreign Students—Edgar J. Fisher, *Chairman*

Membership—Foley F. Smith, *Chairman*

James River Project—Marcellus H. Stow, *Chairman*

Resource-Use Education—Alfred L. Wingo, *Chairman*

Virginia Flora—A. B. Massey, *Chairman*

Virginia Fauna—Horton H. Hobbs, *Chairman*

Virginia Journal of Science—Horton H. Hobbs, *Technical Editor*
Science Museum—George W. Jeffers, *Chairman*
Place of Meeting for 1951—Horton H. Hobbs, *Chairman*
Local Arrangements—P. M. Patterson, *Chairman*
Institute for Scientific Research—Allan T. Gwathmey, *Chairman*
New Business

FRIDAY, MAY 12, THE HOTEL ROANOKE
ROANOKE, VIRGINIA

8:00 A. M.—Registration in the Colonial Room.
9:00 A. M.—Section Meetings.
Agricultural Sciences, Parlor H
Astronomy, Mathematics, and Physics, Parlor A
Bacteriology, Parlor L
Biology, Parlor B
Chemistry, Ballroom
Education, Parlor K
Engineering, Writing Room next to Pine Room
Geology, Parlor F
Medical Sciences, Parlor D
Psychology, Pine Room
Science Teachers, Board Room, N. & W. Office Building
Statistics, Parlor E (Saturday, Parlor F)
10:00 A. M.—Industrial Tour for Junior Academy members, subject to its being elected by a sufficient number of Juniors.
12:30 P. M.—Radio Program.
12:30 P. M.—Luncheon for members of collegiate chapters and other collegiate members (see bulletin board for place).
12:30 P. M.—Group Luncheons.
2:00 to 4:00 P. M.—Section Meetings.
4:00 P. M.—Section meetings adjourned. Junior and Senior members of the Academy to be guests at a reception at Hollins College in their honor.
7:30 P. M.—Academy Dinner, Ballroom. Tickets must be obtained at the registration desk by Friday noon. Dress, informal.
Presiding—Boyd Harshbarger.
Welcome—Bessie Carter Randolph, President, Hollins College.
H. Sherman Oberley, President, Roanoke College.
Presentation of J. Shelton Horsley Research Award.

Report of Nominating Committee.
Report of Committee on Resolutions.
Report of Place of Meeting Committee.
Installation of Officers for 1950-51.

8:30 P. M.—Address—Russell S. Poor, Chairman, University Relation Division, Oak Ridge Research Institute of Nuclear Studies.
"The Impact of Atomic Energy on Southern Education"

SATURDAY, MAY 13, THE ROANOKE HOTEL
ROANOKE, VIRGINIA

9:00 A. M.—Section Meetings.
10:00 A. M.—Statistics, Parlor F.
10:00 A. M.—Academy Council Meeting, Parlor K.
2:00 P. M.—Field Trips (see bulletin boards for further information).

Section of Agricultural Sciences

S. B. FENNE, *Chairman*
S. F. THORNTON, *Vice-Chairman*
M. M. PARKER, *Secretary*

FRIDAY, MAY 12, 1950 — 9:15 A. M. — PARLOR H

1. 9:15 Trends in Vegetable Research.
V. A. Tiedjens, *Virginia Truck Experiment Station.*
2. 9:35 The Use of Sulphur Dioxide for Preserving the Top Layer of Silage.
P. M. Reaves and R. A. Sandy, *Virginia Polytechnic Institute.*
3. 9:55 New Fungicides for Tomato Late Blight Control.
S. A. Wingard and R. G. Henderson, *Virginia Agricultural Experiment Station.*
4. 10:15 Results of Some of the Newer Fungicides in Controlling Powdery Mildew of Fall Snap Beans.
R. S. Mullin, *Virginia Truck Experiment Station.*
5. 10:35 The Use of Sulphur Dioxide in the Liquid Form for the Prevention of the Growth of Fungus (mold) in Silage and Hay, the Saving of Nutritional Values Now Lost in the Making of Silage and Hay and For the Treatment of Fungus Skin Diseases.
Charles W. Johnston, *Virginia Smelting Company.*

6. 10:55 Results of Nematode Resistant Lima Bean Tests Conducted at Walkerton, Virginia, 1949.
Flood S. Andrews, *Virginia Agricultural Experiment Station.*

7. 11:15 Some Notes on the Sycamore Leaf Roller (*Ancylis platanana* Clem) and its control.
G. W. Underhill, *Virginia Agricultural Experiment Station.*

8. 11:30 Stem Nematode—The Cause of a New Alfalfa Disease in Virginia.
R. G. Henderson, *Virginia Agricultural Experiment Station.*

9. 11:45 The Effect of Honey Bees on the Pollination of Crimson Clover.
J. M. Amos, *Virginia Agricultural Extension Service.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

10. 2:00 The Effect of Various Fertilization on Quality and Quantity of Corn Produced.
J. A. Lutz, *Virginia Agricultural Experiment Station.*

11. 2:20 Winning Paper, related to Agriculture, Virginia Science Talent Search.

12. 2:25 The Effect of Soil Fumigants on Nodulation and Nematode Infection of Peanuts.
Lawrence I. Miller, *Virginia Agricultural Experiment Station.*

13. 2:50 Late Season Build-up of the European Red Mite (*Paratetranychus pilosus* Can. and Fanz.) in 1949 in Virginia.
G. W. Underhill, *Virginia Agricultural Experiment Station.*

14. 3:00 Rank Order Evaluation by Use of Triangle Test.
Lyle L. Davis, *Virginia Agricultural Experiment Station.*

15. 3:20 The Outlook for Agricultural Research in Virginia.
H. N. Young, *Virginia Agricultural Experiment Station.*

16. 3:35 Full Brother Diallel Cross in Poultry.
James H. Bywater and Clayton E. Holmes, *Virginia Agricultural Experiment Station.*

3:50 Business Meeting and Election of Officers.

Section of Astronomy, Mathematics and Physics

THOMAS E. GILMER, *Chairman*
A. MARGUERITE RISLEY, *Secretary*

FRIDAY, MAY 12, 1950 — 9:30 A. M. — PARLOR A

1. 9:30 Magnetic Suspension Balance.
   J. W. Beams, *University of Virginia.*
2. 9:45 A High Speed Rotating Mirror.
   E. C. Smith and J. W. Beams, *University of Virginia.*
3. 10:00 Flame Propagation in Cylindrical Tubes at Low Pressure.
   L. B. Snoddy, J. W. Beams, E. E. Hackman and J. L. Young, III, *University of Virginia.*
4. 10:15 Production of High Current High Energy Electron Pulses of Short Duration.
   G. W. Clark and L. B. Snoddy, *University of Virginia.*
5. 10:30 The Existence of Photons Under 26 cms. Pb in Cosmic Ray Air Showers.
   Frank L. Hereford, *University of Virginia.*
6. 10:45 Determination of Minimum Spark Ignition Energy.
   C. A. Gregory, Jr., *Experiment Incorporated.*
7. 11:05 Proofs by "Consecutive Rationals."
   B. Z. Linfield, *School of Mathematics, University of Virginia.*
8. 11:20 Internal Errors of Astrometric Plates.
   Harold L. Alden, *Leander McCormick Observatory, University of Virginia.*
9. 11:30 Period-Spectrum Relation among Classical Cepheids.
   Arthur D. Code, *Leander McCormick Observatory, University of Virginia* (Introduced by Harold L. Alden).
10. 11:40 Efficiency of the Thermoelectric Process.
    G. Preston Burns, *Mary Washington College of the University of Virginia.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

11. 2:00 A Simple Sound Interference Experiment.
    I. G. Foster and J. B. Newman, *Virginia Military Institute.*
12. 2:10 Systems of Numbers
    John William Layman, Honorable Mention, National Science Talent Search, *Blacksburg High School, Blacksburg.*
13. 2:20 A New Method for the Study of Flow through Screens and other Fabric-Like Structures.

S. E. Penner and A. F. Robertson, *Institute of Textile Technology* (Introduced by George H. Coleman).

14. 2:40 Dissociation of Sodium Chloride by Electron Bombardment.
James B. Newman, *Virginia Military Institute.*

15. 2:50 Infrared Spectra—The V_3 Fundamental of Nitrous Oxide.
K. B. Rhodes, *Virginia Military Institute.*

16. 3:05 A Magnetic Suspended Ultracentrifuge with Air Turbine Drive.
J. D. Ross, *University of Virginia.*

3:20 Business Meeting and Election of Officers.

17. 3:30 Discussion: Physics in Virginia Education.
Led by A. D. Campbell, *Hampden-Sydney College.*

SATURDAY, MAY 13, 1950 — 9:30 A. M.

18. 9:30 Use of "Chronotron" for Resolving Time Sequences in Spectral Phenomena.
Fielding M. McGehee, *University of Virginia.*

19. 9:45 A Coincidence Scintillation Counter Apparatus.
Forrest P. Clay, *University of Virginia.*

20. 9:50 Electron Optical Schlieren Method Applied to Measuring Contact Potential Differences and Investigating Electric Fields at Surface of Single Metal Crystals.
Douglas Venable, *University of Virginia.*

21. 10:00 An Improved Form of Rigidity Modulus Apparatus.
H. Y. Loh, *Virginia Polytechnic Institute.*

22. 10:15 A High Voltage Rectified Alternating Current Source for Spectrum Analysis.
Warren H. McInteer, *Virginia Polytechnic Institute.*

23. 10:30 The Curriculum for Physics Majors at the Virginia Military Institute.
S. Murray Heflin, *Virginia Military Institute.*

24. 10:45 Phase Changes in Thin Film Interference.
I. G. Foster, *Virginia Military Institute.*

Section of Bacteriology

GEORGE MCL. LAWSON, *Chairman*
J. DOUGLAS REID, *Vice-Chairman*
WILLIAM A. DORSEY, *Secretary*

FRIDAY, MAY 12, 1950 — 10:00 A. M. — PARLOR L

1. 10:00 A Study of Proteus Species Isolated from the Brown Rat.
   Donald L. Baxter, *University of Richmond, Richmond.*
2. 10:30 A Bacteriophage Against *Clostridium perfringens.*
   B. H. Caminita and J. E. Faber, Jr., *University of Maryland, College Park, Maryland.*
3. 10:50 Antigenicity of Certain Extracts of *Brucella abortus.*
   J. W. Foster, P. Arne Hansen and John E. Faber, Jr., *University of Maryland, College Park, Maryland.*
4. 11:10 The Effect of Gastric Mucin on the Infectivity of Fungi Responsible for Certain Systemic Infections.
   Muriel M. Jones, *Medical College of Virginia, Richmond.*
5. 11:30 Cultivation Studies on *Endamoeba histolytica.*
   E. Clifford Nelson, *Medical College of Virginia, Richmond.*
6. 11:50 The Influence of Thiamine on the Growth and Colony Appearance of *Sporotrichum schenckii* on a Synthetic Medium.
   J. Douglas Reid, *Medical College of Virginia, Richmond.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

7. 2:00 Ecological Survey of Certain Possible Enteric Pathogens in Wild Rats.
   J. M. Sharpley, *University of Richmond, Richmond.*
8. 2:20 In Service Training for Public Health Laboratory Workers; a Cooperative Project Between the University of Richmond and the City of Richmond, Department of Health.
   Robert F. Smart and J. M. Sharpley, *University of Richmond and Bureau of Laboratories, City of Richmond, Richmond.*
9. 2:40 Comparison of Cultural and Microscopic Methods in the Examination of Sputum for Tubercle Bacilli.
   Ralph D. Hughes, *Virginia State Department of Health, Richmond.*

3:00 Business Meeting.

Section of Biology

MARY E. HUMPHREYS, *Chairman*
HORTON H. HOBBS, JR., *Vice-Chairman*
A. M. SHOWALTER, *Secretary*

FRIDAY, MAY 12, 1950 — 9:10 A. M. — PARLOR B

1. 9:10 Some Considerations of the Quail Study on the Virginia Polytechnic Institute Farms.
   Walter S. Overton, Jr., *Virginia Polytechnic Institute.*
2. 9:20 The Present Status and Estimated Distribution of the White-Tail Deer in Virginia.
   James W. Engle, Jr., *Virginia Polytechnic Institute.*
3. 9:30 A Cytological Study of the Eosinophil in *Lumbricus terrestris.*
   Zoe Black, *Mary Washington College of the University of Virginia.*
4. 9:35 The Nutrition of the Ovum of a Fresh-Water Nemertean Worm.
   Solomon Kadis, *Miller School of Biology, University of Virginia.*
5. 9:48 Mimicry in Amphibians, with Particular Reference to the Pattern of Southern Mountain Dusky Salamander, *Desmognathus ochrophaeus carolinensis.*
   John Thornton Wood, *Virginia Fisheries Laboratory, Yorktown.*
6. 10:00 Eggs of the Two-lined Salamander, *Eurycea b. bislineata.*
   John Thornton Wood, *Virginia Fisheries Laboratory, Yorktown.*
7. 10:15 Observations on the Ecological Distribution of Three Virginia Crayfishes.
   Horton H. Hobbs, Jr., *Miller School of Biology, University of Virginia.*
8. 10:30 The Life History of *Gerris canaliculatus* Say. (Hemiptera: Gerridae).
   Marvin L. Bobb, *Virginia Agricultural Experiment Station, Research Laboratory, Charlottesville.*
9. 10:45 Male Haploidy in an Anoetid Mite.
   Roscoe D. Hughes and Caroline O. Goode, *Medical College of Virginia.*
10. 11:00 The Genus *Pterodrilus* in Virginia.
    Perry C. Holt, *University of Richmond.*
11. 11:15 Nutrition of Insects: A Review.
    Warren Moore, *Consulting Entomologist, Raphine.*

11:30 Business Session.
Unscheduled reports and discussion.

FRIDAY, MAY 12, 1950 — 2:00 P. M.

12. 2:00 A New Research Tool and Technique for the Biologist.
Erling S. Hegre, *Medical College of Virginia.*

13. 2:15 Cytogenetic Studies on the *Boraginaceae.*
Donald M. Britton, *The Blandy Experimental Farm, University of Virginia, Boyce.*

14. 2:30 Fertile F_1 and Backcross Hybrids Between Two *Zephyranthes* Species with Different Chromosome Numbers.
W. S. Flory, Jr., *The Blandy Experimental Farm, University of Virginia.*

15. 2:45 The Inheritance of Fruit Shape in a Variety of *Cucurbita moschata.*
A. M. Showalter, *Madison College.*

16. 3:00 Heterosis in Populations with a Pericentric Inversion.
Max Levitan, *Virginia Polytechnic Institute* (Introduced by I. D. Wilson).

17. 3:15 Acidity-alkalinity of the Alimentary Canal of Twenty Insect Species.
James McD. Grayson, *Virginia Agricultural Experiment Station, Blacksburg.*

18. 3:30 Response of the German Cockroach to the Sublethal Concentrations of DDT and Benzene Hexachloride: Progress Report.
James McD. Grayson, *Virginia Agricultural Experiment Station, Blacksburg.*

3:45 Unscheduled Reports.

The Committee on Virginia Flora plans a field trip on Saturday afternoon, May 13, into some of the National Forest areas near Buchanan and Natural Bridge.

Section of Chemistry

A. R. ARMSTRONG, *Chairman*
J. R. TAYLOR, *Secretary*

FRIDAY, MAY 12, 1950 — 9:15 A. M. — BALLROOM

1. 9:15 Opening Remarks.
   A. R. Armstrong. *College of William and Mary.*
2. 9:30 Determination of Fluorine in Fluoro-Organic Compounds.
   James W. Cole, Jason M. Salsbury, Lyle G. Overholser, and John H. Yoe, *University of Virginia.*
3. 9:45 Determination of Small Quantities of Volatile Fluoro-Organic Compounds in Air.
   James W. Cole, Jason M. Salsbury, and John H. Yoe, *University of Virginia.*
4. 10:00 Determination of Small Quantities of Fluoro-Organic Compounds in Water.
   Alfred R. Armstrong, *College of William and Mary;* Jason M. Salsbury, James W. Cole, and John H. Yoe, *University of Virginia.*
5. 10:15 Suppression of Cyanogen Bands in Spectrochemical Analysis.
   Ralph E. Thiers, *Pratt Trace Analysis Laboratory, University of Virginia.*
6. 10:30 A Study of the Rare-Earth Elements in Human Bones.
   J. E. Johnson and J. B. Lucas, *Virginia Polytechnic Institute.*
7. 10:45 Determination of Iron and Aluminum as Applied to the Analysis of Georgia Bauxite: Sections I, II, and III.
   Betty Wright Williams, Julia T. Gary, Barbara Montague, and Helen L. Whidden, *Randolph-Macon Woman's College.*
8. 11:15 Biological Detection of Vitamines in Wool.
   Warren Moore, *Raphine, Va.*
9. 11:30 The Preparation of Carcinogenic Hydrocarbons by Aromatic Cyclo-dehydration.
   F. A. Vingiello, *Virginia Polytechnic Institute.*
10. 11:45 The Synthesis of Some *m'* - Substituted Phenyl - *o* - Benzyl - Benzophenones.
    F. A. Vingiello, J. G. VanOot, and H. H. Hannabass[1], *Virginia Polytechnic Institute.*

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[1] Present address—Tennessee Eastman Corp., Kingsport, Tennessee.

FRIDAY, MAY 12, 1950 — 2:00 P. M.

11. 2:00 Visual Study of Dye Distribution on Cellulose Fibers.
L. C. Pittman, Jr., and Dudley Thompson, *Virginia Polytechnic Institute.*

12. 2:15 Ultrasonic Crystallization of Alumina Trihydrate.
Dudley Thompson and J. J. Cassady, Jr., *Virginia Polytechnic Institute.*

13. 2:30 The Microscopy of the Effect of Electrolytes upon Clay-Water Suspensions.
W. T. Withers and Dudley Thompson, *Virginia Polytechnic Institute.*

14. 2:45 The Effect of Molecular Structure on Burning Velocity.
A. R. Sharpe, Jr., C. M. Barnett, and H. F. Calcote, *Experiment Incorporated.*

15. 3:00 Knocking Characteristics of Fuels with the German Jentzsch Tester.
R. B. Gilmer and H. F. Calcote, *Experiment Incorporated.*

16. 3:15 Monomolecular Films.
Anne Louise Davis, Honorable Mention, National Science Talent Search, *Wilson Memorial High School, Staunton.*

17. 3:25 A Study of Zinc Compounds.
Camden Ballard Pierce, Honorable Mention, National Science Talent Search, *Huntington High School, Newport News.*

18. 3:30 N-Aryl N'-Alkyloxamides.
A. G. Richardson, J. Stanton Pierce, and E. Emmett Reid, *University of Richmond.*

19. 3:45 Changes in the Beta-Glucosidase Activity of Sweet Almond Emulsin by Adsorption Methods.
Martha Jean Lowe and Helen L. Whidden, *Randolph-Macon Woman's College.*

4.00 Business Meeting and Election of Officers.

SATURDAY, MAY 13, 1950 — 9:00 A. M.

20. 9:00 Reaction of Tris = (Hydroxymethyl) Aminomethane.
J. Stanton Pierce, Carl D. Lunsford, Ralph W. Raiford, Jr., Julian Lee Ruth and Douglas W. Wiley, *University of Richmond.*

21. 9:15 The Preparation of Some Acetylenic Fatty Acids.
J. Doyle Smith, *Medical College of Virginia.*

22. 9:30 A Study of the Light Catalysed α Halogenation of o Benzylbenzophenone.
F. A. Vingiello and R. A. Kasey, Jr., *Virginia Poly-*

technic Institute.

23. 9:45 The Synthesis of 9-Cyclohexylanthracene and Its Purification by Chromotography.
F. A. Vingiello and H. H. Hannabass[1], *Virginia Polytechnic Institute.*

24. 10:00 The Synthesis of Some *o'* and *m'* Substituted Phenyl - *o* - Benzylbenzophenones, and Some *o'*, *m'*, and *p'* Substituted *o'* - Benzoyl-Diphenylmethanes.
(To be read in title only)
F. A. Vingiello, *Virginia Polytechnic Institute.*

25. 10:00 The Synthesis of *O* - Benzylketones Having a Strongly Electonegative Group Attached to the Carbonyl Group.
F. A. Vingiello and G. J. Buese, *Virginia Polytechnic Institute.*

26. 10:15 The Remodelling of the Chemistry Laboratories at Virginia Military Institute.
L. German, *Virginia Military Institute.*

27. 10:30 The Rate of Diffusion of Mercury Through Pyrex Tubing of Various Diameters.
Richard M. Irby, Jr. and W. E. Trout, *University of Richmond.*

28. 10:45 X-Ray Studies of Oxide Films on Copper Single Crystals.
Kenneth R. Lawless, *University of Virginia.*

29. 11:00 The Use of Polarized Light for the Measurement of Film Thickness.
Fred W. Young, *University of Virginia.*

30. 11:15 Some Electrochemical Properties of Copper Crystals.
Lewis B. Johnson, *University of Virginia.*

31. 11:30 Certain Aspects of the Growth of Copper Crystals.
John V. Cathcart, *University of Virginia.*

32. 11:45 Migration of Copper Atoms across the Surface of a Massive Single Crystal of Copper.
G. Pedro Smith, *University of Virginia.*

33. 12:00 On-Track Research of Chemical Herbicides Applicable to Roadbed Weed Control for Southeastern Railroads.
Jack P. Taylor and Frank C. Vilbrandt, *Virginia Polytechnic Institute.*

34. 12:15 The Distribution of Certain Chemical and Physical Properties in the Chesapeake Bay and its Tributaries during the Summer and Early Fall of 1949.
Donald W. Pritchard, Wayne V. Burt, and Dayton E. Carritt, *Chesapeake Bay Institute.*

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[1] Present address--Tennessee Eastman Corp., Kingsport, Tennessee.

Section of Education

EDWARD F. OVERTON, *Chairman*
R. CLAUDE GRAHAM, *Secretary*

FRIDAY, MAY 12, 1950 — 9:30 A. M. — PARLOR K

1. Announcements and Appointment of Committees.
2. Mathematics and Science Offerings in Virginia's Public Schools:
   a. The Mathematics Offering in Virginia High Schools.
      Francis G. Lankford, Jr., Associate Professor of Education, *University of Virginia* and Benjamin T. Cullen, Graduate Student, *University of Virginia.*
   b. Science in Virginia Secondary Schools.
      Percy H. Warren, Professor of Biology, *Madison College.*
3. Evaluation and Testing.
   a. The Evaluative Criteria, Cooperative Study of Secondary School Standards, 1950 Edition.
      William R. Smithey, Professor of Secondary Education, *University of Virginia.*
   b. The Testing Program of the State Board of Education of Virginia.
      Alfred L. Wingo, Supervisor of Research, *State Department of Education.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

4. A Follow-Up Study of the 1940 Graduates of John Marshall High School, Richmond, Virginia.
   Mrs. Elmira Maurice, Teacher, *Bainbridge Junior High School.*
5. A Study of Certain School Leavers at Mount Pleasant School, Roanoke County, Virginia.
   Mrs. Rae Webb Scott, Principal, *Mount Pleasant School.*
6. Effects of Perceptual Training on Group IQ Scores of Children in Rural Elementary Schools.
   Jack Boger, Graduate Student, *University of Virginia.*
7. Motivation of the Science Student Through Research Projects.
   John Thornton Wood, *Virginia Fisheries Laboratory, Yorktown, Virginia.*
8. Determining Reading Difficulty of Experiment Station Bulletins.
   Alonzo M. Myster, Professor of Experimental Statistics, *Virginia State College.*
9. The Evolving Philosophy of the Junior or Community College.
   L. X. Magnifico, Associate Professor of Educational Psychology and Head of the Department of Psychology, *Richmond Professional Institute.*

10. Some reasons for the Failures of College Students.
    A. W. Hurd, Director, Bureau of Educational Research and Service, *Medical College of Virginia.*
11. A Comparison of the Actual Distribution of the 1946-47 State Funds for Public Schools with a Distribution of the Same Funds Based Upon a Formula Involving Ability, Effort and Need.
    John L. Lancaster, Research Associate, Bureau of Population and Economic Research, *University of Virginia.*

Business Meeting.

Each paper will be followed by a discussion.

Section of Engineering

NELSON F. MURPHY, *Chairman*
R. E. L. GILDEA, *Secretary*

FRIDAY, MAY 12, 1950 — 9:15 A. M. — WRITING ROOM
(next to Pine Room)

1. 9:30 A Study of Structural Southern Pine.
   Oscar Jennings Blake, *Virginia Polytechnic Institute.*
2. 9:45 Wood Box Columns.
   Bertram Y. Kinzey, Jr., *Virginia Polytechnic Institute.*
3. 10:00 Introducing a New Improved Nail.
   E. George Stern, *Virginia Polytechnic Institute.*
4. 10:15 Determination of the Torsional Stress Concentration in the Fillets of Factor Hollow Stepped Shafts.
   E. W. Tobin and W. R. Pierce, *Virginia Polytechnic Institute.*
5. 10:30 Stresses Around a Loaded Hole in a Quarter Infinite Plate.
   W. L. Brunschwyler, *Interstate Equipment Co.,* and D. H. Pletta, *Virginia Polytechnic Institute.*
6. 10:45 New Method Designing Shrinkfit Cylinders.
   A. P. Carpenito, and V. G. Szebehely, *Virginia Polytechnic Institute.*
7. 11:00 Observations on Orifice Plate Stresses at Pressures Excess of 20,000 P.S.I.
   B. A. Niemeier, *Experiment Incorporated.*
8. 11:15 Two Samples of Prestressed Concrete Construction in France.
   P. L. Melville, *University of Virginia.*
9. 11:30 Corrosion Protection of Thin Precast Concrete Sections.
   E. F. Massie, *Montague and Betts,* D. H. Pletta, and

H. S. Robins, *Virginia Polytechnic Institute.*

10. 11:45 Aerodynamic Stability of Oscillating Bridges.
J. B. Eades, *Virginia Polytechnic Institute;* C. E. Spruill, *Grumman Aircraft Co.*

FRIDAY, MAY 12, 1950 — 1:50 P. M.

11. 1:50 A Demonstration Slide Rule.
Edward Carroll Smith, *Huntington High School, Newport News,* Honorable Mention, National Science Talent Search.

12. 1:55 Treatment of French Plastic Mass.
Claire June Millhiser, *Thomas Jefferson High School, Richmond,* Honorable Mention, National Science Talent Search.

13. 2:00 Flow Problems of Variable Viscosity.
V. G. Szebehely, *Virginia Polytechnic Institute.*

14. 2:15 Investigation of the Cooling Characteristics of Rotating Liquids.
Stanislaw S. Wulc, *Interstate Equipment Co.*

15. 2:30 Correlation of Maximum Heat Flux with Critical Driving Force from a Horizontal Copper Surface to the Systems Ethanol-Water and Ethylene Glycol-Water.
F. W. Bull and R. V. Davis, *Virginia Polytechnic Institute.*

16. 2:45 Effects of the More Common Physical Constants, in Oil-Gas Systems on the Solubility Properties of Oils.
Floyd H. Fish, Jr., *Virginia Polytechnic Institute.*

17. 3:00 Corrosion of Metals by Glycerine Solutions.
T. F. Lynch and N. F. Murphy, *Virginia Polytechnic Institute.*

18. 3:15 Inhibitors for Corrosion of Copper in Phosphoric Acid.
H. D. Decker and N. F. Murphy, *Virginia Polytechnic Institute.*

19. 3:30 Effect of Sodium Nitrate on Corrosion Rate of Steel in Five per cent Phosphoric Acid.
R. H. Shackelford and N. F. Murphy, *Virginia Polytechnic Institute.*

SATURDAY, MAY 13, 1950 — 9:00 A. M.

20. 9:00 New Chemical Engineering Facilities for the University of Virginia.
Robert M. Hubbard, *University of Virginia.*

21. 9:15 Development of Ultrasonics Program at Virginia Polytechnic Institute.
Dudley Thompson, *Virginia Polytechnic Institute.*

22. 9:30 Patterns of Chemurgic Industries Applicable to the Virginia Economy.
R. J. Golladay, C. S. Martin, R. L. Havens, and Frank C. Vilbrandt, *Virginia Polytechnic Institute.*

23. 9:45 Nomograph for Solubility Isotherms for the System: Sodium Sulfate - Ethylene Glycol-Water.
J. D. Phillips and D. S. Davis, *Virginia Polytechnic Institute.*

24. 10:00 Generalized Relations for Countercurrent Extraction with Constant Underflow.
Robert M. Hubbard and Carey C. Morgan, *University of Virginia.*

25. 10:15 The Effect of a Wetting Agent (Sodium Lauryl Sulfate) on the Efficiency of the Fractional Liquid Extraction of Ethanol and Isopropanol with Benzene and Water.
J. O. Gonzalez, Jr., G. L. Patram, W. R. Akers, and F. W. Bull, *Virginia Polytechnic Institute.*

26. 10:30 Capacity of Vertical Pipes Carrying Liquid and Gas in Counter-current Flow.
Robert Thomson, Henry P. Voznick, and O. L. Updike, Jr., *University of Virginia.*

27. 10:45 Calibration of a Five Inch Centrifugal Molecular Still.
G. J. Lombardi and F. W. Bull, *Virginia Polytechnic Institute.*

28. 11:00 The Determination of the Extent of Thermal Cracking in a Bench Scale Fixed Bed Vertical Catalytic Cracking Unit.
T. M. Beamon and F. W. Bull, *Virginia Polytechnic Institute.*

29. 11:15 Heat Transfer to an Externally Heated, Fluidized Bed of a Commercial Bead Type Cracking Catalyst.
H. C. Breckon and F. W. Bull, *Virginia Polytechnic Institute.*

30. 11:30 Pilot Plant Distillation Test on Sea Water.
J. D. Cullen, D. C. Spence, J. T. Walmsley, and F. C. Vilbrandt, *Virginia Polytechnic Institute.*

31. 11:45 Hypersorption Process for the Vapor-Phase Separation of Carbon Disulfide and Hydrogen Sulfide.
L. A. Caplan and F. W. Bull, *Virginia Polytechnic Institute.*

Section of Geology

TILTON E. SHELBURNE, *Chairman*
CHARLES E. SEARS, JR., *Vice-Chairman*
WILLIAM M. MCGILL, *Secretary*

FRIDAY, MAY 12, 1950 — 9:00 A. M. — PARLOR F

9:00 Announcements, Committee Reports.

1. 9:10 Some Plans and Projects of the Virginia Geological Survey.
William M. McGill, *Virginia Geological Survey.* (Charts maps, slides, 10 min.).

2. 9:23 Mineralogical Studies of the Sediments of Hardware River, Albemarle and Fluvanna Counties, Virginia.
P. E. Forkgen, W. H. Hunt and R. R. McDonald, *Washington and Lee University.* (Presented by R. R. McDonald). (Introduced by M. H. Stow). (Maps, charts, thin sections, 10 min.).

3. 9:36 Mineralogical Studies of the Sediments of Partridge Run, Amherst County, Virginia.
C. C. Humphries, R. W. Hynson and R. E. Whitson, *Washington and Lee University.* (Presented by R. W. Hynson). (Introduced by M. H. Stow) .(Maps, charts, thin sections, 10 min.).

4. 9:49 The Geology and Petrography of Metapyroxenites in Virginia.
Arthur A. Pegau, *Virginia Geological Survey.* (10 min.).

5. 10:04 A Petrographic Study of a Dikelike Structure Occurring at McCormick Overlook on the Skyline Drive, Augusta County, Virginia.
Buster W. Miller and Robert S. Young, *University of Virginia.* (Presented by Buster W. Miller). (Introduced by Wilbur A. Nelson). (Slides, 8 min.).

6. 10:15 Occurrence and Origin of Limonite and Malachite in Montgomery County, Virginia.
Charles E. Sears, Jr., *Virginia Polytechnic Institute.* (Maps, slides, specimens, 15 min.).

7. 10:34 Stratigraphic and Structural Control of Zinc Deposits in the Timberville Area, Virginia.
Jack Green and Frank G. Lesure, *Virginia Polytechnic Institute.* (Presented by Jack Green). (Introduced by Rhesa M. Allen). (Slides, 10 min.).

8. 10:47 The Use of Geology in Forest Management in the Jefferson National Forest, Virginia.
Paul W. Sundheimer, *Forester, U.S. Forest Service, Jef-*

ferson National Forest. (Introduced by William M. McGill). (Maps, slides, 15 min.).

9. 11:07 Geologic Construction Materials in Albemarle County, Virginia.
William T. Parrott, *Virginia Department of Highways.* (Slides, 10 min.).

10. 11:21 Mechanical and Chemical Loads of Some Virginia Streams.
Rhesa M. Allen, Jr., *Virginia Polytechnic Institute.* (Slides, 15 min.).

11. 11:41 Coefficients of Transmissibility and Storage Determined for Potomac Sands in the Franklin Area, Virginia.
Allen Sinnott, *Geologist, U.S. Geological Survey.* (Slides, 10 min.).

12. 11:56 Upper Cretaceous Beds in the Coastal Plain of Virginia.
D. J. Cederstrom, *Geologist, Ground Water Branch, U.S. Geological Survey.* (Maps, charts, 10 min.).

13. 12:10 A Possible Explanation of Normal Beds Bounded by Overturned Beds in the Unicoi Formation on the Northwest Flank of the Blue Ridge on U.S. Route 250, Virginia.
Horace B. Cooke, II, *University of Virginia.* (Introduced by Wilbur A. Nelson). (Slides, 6 min.).

14. 12:20 Geology of the Shenandoah of Virginia.
Betty Campbell Cook, Honorable Mention, National Science Talent Search, *Wilson Memorial High School, Staunton.* (10 min.).

12:30 Appointment of Committees; Announcements.

FRIDAY, MAY 12, 1950 — 2:00 P. M.

2:00 Announcements, Committee Reports.

15. 2:10 Geological Aspects of Engineering-Soil Reconnaissance.
Lowell E. Gregg, *Associate Director of Research, Kentucky Highway Department.* (Introduced by Tilton E. Shelburne). (Slides, 30 min.).

16. 2:46 Strip Map of Engineering Materials along State Route 7, Loudoun County, Virginia.
J. C. Stevens, *Virginia Council of Highway Investigations and Research.* (Introduced by Tilton E. Shelburne). (Slides, 15 min.).

17. 3:06 Significance of Hayter Fans in the Geomorphic History of the Appalachian Ridges of Western Virginia.
Byron N. Cooper, *Virginia Polytechnic Institute.* (Slides, 20 min.).

18. 3:32 A Revision of the Structure and Stratigraphy of the Blue Ridge and Piedmont Area in Albemarle County, Virginia.

Wilbur A. Nelson, *University of Virginia.* (Maps, slides, 12 min.).

19. 3:50 Oil and Gas Possibilities in the Bergton District, Rockingham County, Virginia.
Wilbur T. Harnsberger, *Virginia Geological Survey.* (Maps, slides, 10 min.).

20. 4:04 Oil and Gas Laws and Their Application to Virginia.
W. F. Stickle, *Washington and Lee University.* (Introduced by M. H. Stow). (10 min.).

21. 4:18 Geology of Fredericksburg and Vicinity, Virginia.
James R. Burns, *University of Virginia.* (Slides, 10 min.).

22. 4:32 The Chepultepec in Virginia.
R. S. Edmundson, *University of Virginia.* (Maps, slides, 8 min.).

4:45 Business Meeting.
Announcements; Reports of Committees; Election of Officers.

SATURDAY, MAY 13 — 8:15 A. M.

Geological Field Trip.
Details of trip and place of assembly will be announced at Friday's meetings.

Section of Medical Sciences

WILLIAM BICKERS, *Chairman*
ERLING S. HEGRE, *Secretary*

FRIDAY, MAY 12, 1950 — 9:30 A. M. — PARLOR D

1. The action of Mecurial Compounds on Saccharase.
C. L. Gemmill and E. M. Bowman, *Department of Pharmacology, University of Virginia Medical School, Charlottesville.*

2. Thermodynamics of Saccharase Action.
F. C. Holler, *Department of Pharmacology, University of Virginia Medical School, Charlottesville.*

3. Some Effects of the Insecticide Ryanodine on Frog Tissues.
Marie Louise Flinker, Robert W. Ramsey and Leslie E. Edwards, *Department of Physiology and Pharmacology, Medical College of Virginia, Richmond.*

4. Action of Enzyme Inhibitors on the Increased Oxygen Uptake of Skeletal Muscle Produced by Ryanodine.
Leslie E. Edwards, Marie Louise Flinker, *Department of Physiology and Pharmacology, Medical College of Virginia, Richmond.*

5. Clinical Experience with Quick's Prothrombin Consumption Test,

Using Only Two Tubes of Blood.
K. F. Menk and O. B. Bobbitt, *Clinical Pathology Department, University of Virginia School of Medicine, Charlottesville.*

6. Studies on the Process of Phosphate Uptake by Human Erythrocytes.
D. R. H. Gourley, *Department of Pharmacology, University of Virginia Medical School, Charlottesville.*

7. Forensic Serology.
Robert K. Waller, *Office of the Chief Medical Examiner, Richmond.*

8. Active Sodium and Chloride Uptake by Surviving Frog Skin.
Ernst G. Huf and Joyce Parrish, *Department of Physiology, Medical College of Virginia, Richmond.*

9. Chloride in Skeletal Muscle.
Ernst Fischer, Helen V. Skowlund, Kathleen R. Royster, Dorothy M. Whitaker and Eleanor White, *Department of Physiology, Medical College of Virginia, Richmond.*

10. Histopathologic Studies of Abnormal Enamel Formation in Human Teeth.
S. J. Kreshover, *Department of Dental Research, School of Dentistry, Medical College of Virginia, Richmond.*

11. Motion Pictures of Cell Reactions to Implants of Tantalum in Tadpoles.
Carl C. Speidel, *School of Anatomy, University of Virginia Medical School, Charlottesville.*

12. A Million Volt Berryllium Window X Ray Tube.
Fred Schmidt, *Surgical Research Laboratory, Medical College of Virginia, Richmond.*

13. New Way of Determining X Ray Burns in Skin.
James Brooks, Paul Robinett and Everett I. Evans, *Surgical Research Laboratory, Medical College of Virginia, Richmond.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

14. A Polargraphic Method for the Analysis of Digitoxin.
J. G. Hilton, *Department of Pharmacology, University of Virginia Medical School, Charlottesville.*

15. The Effects of Intravenous Injections of a Nitrogen Mustard on the Testes of Albino Rats.
James E. Kindred, *School of Anatomy, University of Virginia Medical School, Charlottesville.*

16. Mass Spectrometry in Physical and Biological Research.
Ray Williams, *Surgical Research Laboratory, Medical College of Virginia, Richmond.*

17. Red Cell Volume in Burn Dogs Measured by Radioactive Phosphorus and T-1824 Dye.
Arnold Salzberg and Everett Evans, *Surgical Research Laboratory, Medical College of Virginia, Richmond.*

18. Hormonal Control of the Reproductive Cycle of Ovoviviparous Snakes as Related to the Evolution of Viviparity.
Douglas E. Bragdan, *School of Anatomy, University of Virginia Medical School, Charlottesville.*

19. Effect of Alcohol Administration on Liver Fat, Heart and Liver Gycogen in the Rat.
J. C. Forbes and G. M. Duncan, *Department of Biochemistry, Medical College of Virginia, Richmond.*

20. The Effect of Wetting Agents on the Lung.
G. C. Hall, Department of Pharmacology, University of Virginia *Medical School, Charlottesville.*

21. The Effect of Methanol, Formaldehyde and Formic Acid on Respiratory Enzyme Systems.
D. T. Watts, *Department of Pharmacology, University of Virginia Medical School, Charlottesville.*

22. The Site of Action of Strychnine in Facilitating Pressor Responses Evoked from the Cerebral Cortex.
E. C. Hoff, H. G. Langford, J. W. Vester, W. W. Beckner, and P. R. Thomas, *Neurological Science Laboratory, Medical College of Virginia, Richmond.*

23. On Secondary Diaschisis and Secondary Release.
Walther Riese, *Department of Psychiatry, Medical College of Virginia, Richmond.*

24. Streptomycin and Pomizole Therapy in the Treatment of Tuberculosis in Children.
L. E. Sutton, Jr., F. L. Angell, W. M. Bruch, K. D. Bailey, and E. L. Kendig, *Medical College of Virginia.*

25. Function of the Adrenal Glands in Gravitational Shock.
E. G. Lewis and S. W. Britton, *Medical School, University of Virginia.*

Section of Psychology

JOHN N. BUCK, *Chairman*
FRANK W. FINGER, *Vice-Chairman*
STANLEY WILLIAMS, *Secretary*

FRIDAY, MAY 12, 1950 — 8:45 A. M. — PINE ROOM

1. 8:45 Psychology and Psychopathology of Reading Difficulties.
   Hertha Riese, *Educational Therapy Center, Richmond.*
2. 9:00 Problems Encountered in Telegraphic Code Learning.
   Raymond C. Bice, *University of Virginia.*
3. 9:15 The Effect of Drive Stimulus Discrimination Training upon Generalization of Secondary Reinforcement.
   A. J. Slivinske, *University of Virginia.*
4. 9:30 The Effect of Discriminability of Serial Position on Verbal Learning.
   Stuart Ashman, *College of William and Mary.*
5. 9:45 Human Salivary Conditioning by the Razran Technique.
   John W. McCrary, Jr., *College of William and Mary.*
6. 10:00 Specific Hunger for Sodium Chloride in White Rats.
   John K. Bare, *College of William and Mary.*

10:15 Fifteen-minute intermission.

7. 10:30 Types of Personal Adjustment Problems Leading to the Referral of War Veterans for Therapeutic Counseling: An Analysis of 200 Cases.
   John E. Partington, *Veterans Administration Regional Office, Roanoke.*
8. 10:45 A Psychological Analysis of the Process of Communication.
   Richard H. Henneman, *University of Virginia.*
9. 11:00 The Intelligibility of Highly Speeded Speech for Communication Purposes.
   William D. Garvey, *University of Virginia.*
10. 11:15 The Effect of an Interfering Task on the Relative Intelligibility of Messages Presented Visually and Aurally.
    T. L. Mathews, *University of Virginia.*
11. 11:30 Visual Illusions in Night-flying.
    Henry A. Imus, *Office of Naval Research.*
12. 11:45 Cybernetics and Psychology.
    W. F. Day, *University of Virginia.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

2:00 Business meeting and election of officers.

13. 2:30 An Experimental Investigation of Kinaesthetic After-effects.
    Bertita Compton, *University of Virginia.*

14. 2:45 Electrical Stimulation and Sensory Fatigue.
Jack A. Vernon, *University of Virginia.*

15. 3:00 Basic Threshold Constants from Vibratory Stimulation.
Carl E. Sherrick, *University of Virginia.*

16. 3:15 The Effect of Auditory Stimulation on Vernier Acuity.
Henry R. Hortenstine, *University of Virginia.*

17. 3:30 A Comparison of the Relative Effectiveness of Several Methods of Presenting Tachistoscopic Material.
Andrew W. Gottschall, Jr., *Washingtand Lee University.*

18. 3:45 Some Additional Notes on a Case of Automatic Drawing.
William M. Hinton, *Washington and Lee University.*

Section of Teachers of Science

L. W. JARMAN, *Chairman*
W. I. NICHELS, *Chairman-Elect*
ESTHER SHREVE RUFFIN, *Secretary*

FRIDAY, MAY 12, 1950 — 9:30 A. M. — BOARD ROOM, N. & W. OFFICE BUILDING

9:30 Announcements.
L. W. Jarman, *Thomas Jefferson High School, Richmond.*

1. 9:40 The Egg, the Sperm and I (Illustrated).
George Jeffers, *Longwood College,* and Susie V. Floyd, *Newport News High School.*

2. 11:00 Demonstration of Inexpensive Equipment that Might be Used in a High School Physics Class.
W. H. Keeble, *Randolph-Macon College.*

2:00 Business Meeting.

3. 2:15 Some Concepts of Energy. (Illustrated)
Frederick L. Brown, *University of Virginia* and John E. Reitz, *Lane High School, Charlottesville.*

4. 3:10 Demonstration of Inexpensive Equipment that Might be Used in a General Science Class in High School.
M. G. Gustaffson, *Swanson High School, Arlington.*

Section of Statistics

W. A. HENDRICKS, *Chairman*
J. M. SYKES, *Vice-Chairman*
M. E. TERRY, *Secretary*

FRIDAY, MAY 12, 1950 — 9:45 A. M. — PARLOR H

1. 9:45 Opening Address.
   W. A. Hendricks, *United States Department of Agriculture.*
2. 10:10 Approximations to Distribution Functions by Moments.
   L. Weiss, *University of Virginia, Charlottesville.*
3. 10:30 Some Problems in the Teaching of Elementary Statistical Methods Courses.
   A. M. Myster, *Virginia State College, Petersburg.*
4. 10:50 Prediction Problems.
   Glenn Suter, *Virginia Polytechnic Institute, Blacksburg.*
5. 11:05 Sampling Approximations to Non-null Distributions for Small Samples.
   F. W. Cleaver, *Virginia Polytechnic Institute, Blacksburg.*
6. 11:25 Use of Multiple Regression Techniques in Studies of Dairy Pedigrees.
   N. Thompson, *Virginia Polytechnic Institute, Blacksburg.*

FRIDAY, MAY 12, 1950 — 2:00 P. M.

7. 2:00 On a Statistical Problem of Fisheries.
   E. L. Cox, *North Carolina State College, Raleigh, North Carolina.*
8. 2:30 Some New Light on an Old Problem in Statistical Inference.
   H. Robbins, *University of North Carolina, Chapel Hill, North Carolina.* (Introduced by W. A. Hendricks).
9. 3:15 Certain Problems in Aviation Medicine.
   Dorothy Morrow, *Civil Aeronautical Administration, Washington, D. C.* (Introduced by M. E. Terry).

3:50 Business Session.

SATURDAY, MAY 13, 1950 — 10:00 A. M. — PARLOR F

10. 10:00 A Note on Tukey's Separation of Varietal Means.
    M. E. Terry, *Virginia Polytechnic Institute, Blacksburg.*
11. 10:15 Some Examples of Sampling Techniques Applied to Bureau of Agricultural Economics.
    G. Burroughs, *United States Department of Agriculture.*

12. 10:55 A Problem of Many Missing Plots.
T. Shien, *Virginia Polytechnic Institute, Blacksburg.*
(Read by M. F. P. Nightingale).

13. 11:10 Designs in Chemistry.
William J. Youden, *Bureau of Standards, Washington, D. C.*